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STUDY OF THE ECONOMIC IMPACT OF SULFUR REGULATIONS PROMULGATED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY FOR OHIO ON AUGUST 27, 1976

STUDY DOCUMENT NUMBER 3. FINANCIAL IMPACT OF THE PROPOSED AND REVISED SULFUR DIOXIDE REGULATIONS IN THE STATE OF OHIO

TEMPLE, BARKER AND SLOANE, INCORPORATED,
WELLESLEY HILLS, MASSACHUSETTS

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FINANCIAL IMPACT OF THE PROPOSED AND REVISED SULFUR DIOXIDE REGULATIONS IN THE STATE OF OHIO

PREPARED FOR

THE U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF PLANNING AND EVALUATION

BY

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16. ABSTRACT

This report is the third volume in support of the Inflation Impact Statement for sulfur dioxide regulations prepared by the U.S. Environmental Protection Agency, to correct deficiencies in the Ohio State Implementation Plan. The Technical Support Document, Volumes I and II may be obtained through the National Technical Information Service EPA 905/2-76-002, PB-257 694 and PB-257 695.

This document and its technical appendix present the direct financial effects of proposed sulfur dioxide regulations on the electric power consumers and the electric utility industry in Ohio. The impact analysis includes engineering cost studies of air pollution control equipment and least-cost optimization of compliance strategies.

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This is Document #3, one in a series of nine documents in support of the Inflationary Impact Statement (Document #1).

INFLATION IMPACT STUDY DOCUMENTATION

This appendix identifies the documents prepared to support the Inflation Impact Analysis of the sulfur oxide regulations prepared by the U.S. Environmental Protection Agency (EPA) for the state of Ohio.

Figure 1 identifies the supporting documents. Document #2 provides an overview of the study methodology and illustrates the depth of analysis contained in the study.

Impact Studies

Documents #3 and 4 are economic impact analyses of the utility and industrial sectors in Ohio. These reports address impacts on prices, output, employment and financial viability. Document #5 summarizes the energy impacts of the regulation in terms of the level of energy demand, shifts from coal to oil likely to occur as a result of compliance with the regulations as well as shifts in coal production patterns. In particular, this report focuses on whether coal production in Ohio, which is generally high in sulfur content, will be adversely impacted.

Cost Minimization

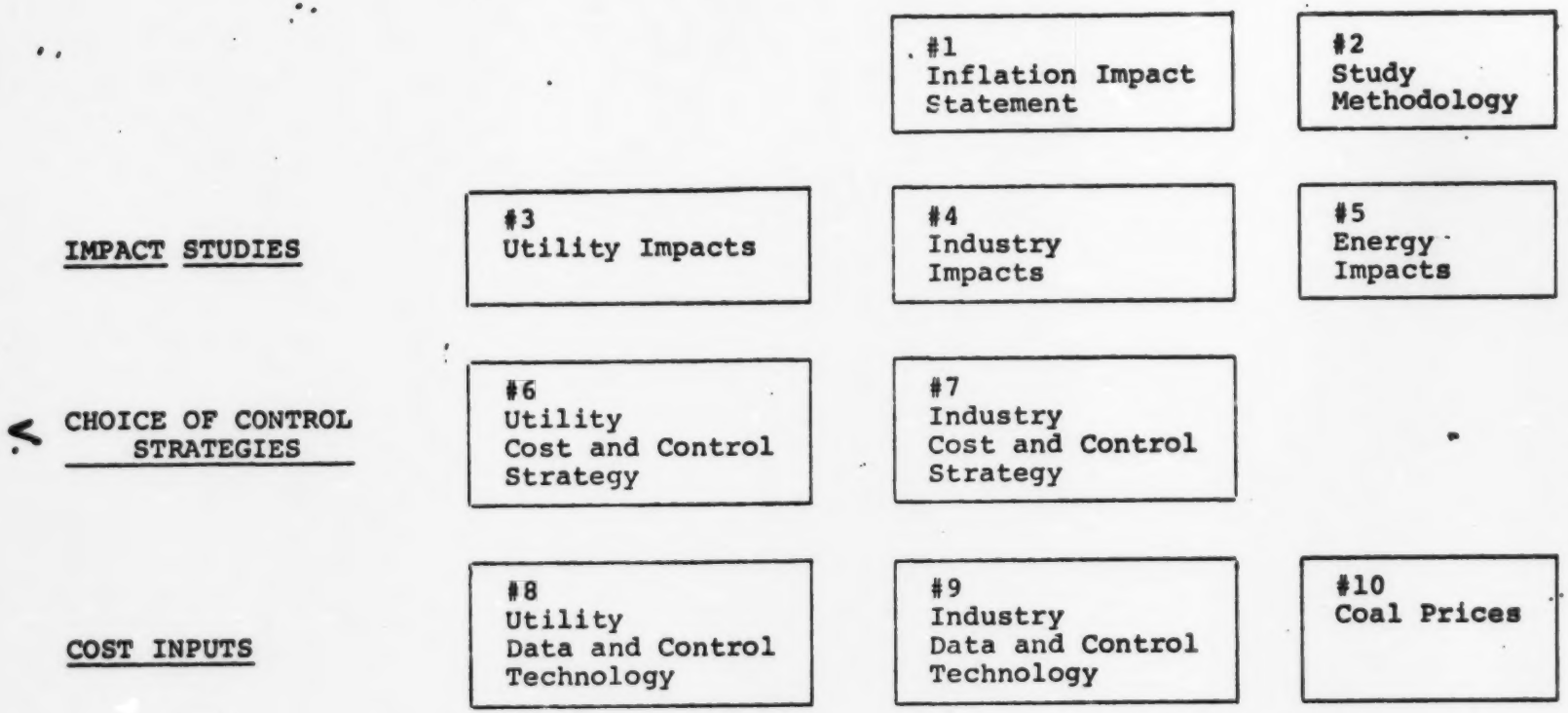
Documents #6 and 7 present the methodology for estimating costs of compliance and the choice of pollution control strategies. For both utility and industry, these supporting documents outline the cost minimizing strategies which provide the basis for the economic and energy impacts discussed in documents #3 - 5.

Cost Inputs

These final documents contain the basic data inputs to the study. Document #8 describes the pollution control technology options, their costs plus basic plant specific parameters which influence costs such as fuel consumption and boiler firing rates.

Figure 1

INFLATION IMPACT STATEMENTS SUPPORTING DOCUMENTS



Document #9 contains similar data on the industrial sector. Document #10 presents the derivation of coal prices employed in this study and used in both the industry and utility sector analysis. The focus is on the price premium of low versus high sulfur coal.

PREFACE

This report has been submitted to the United States Environmental Protection Agency in partial fulfillment of Contract No. 68-01-2803 by Temple, Barker & Sloane, Inc., 15 Walnut Street, Wellesley Hills, Massachusetts.

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CHAPTER 1
INTRODUCTION AND CONCLUSIONS

This report presents the direct financial effects of proposed sulfur dioxide regulations on the electric power consumers and the electric utility industry in the State of Ohio. The specific pollution control regulations considered in this report are the regulations covering sulfur dioxide (SO_2) emissions at existing fossil fuel generating plants published by the U.S. Environmental Protection Agency (EPA), Region V, on November 10, 1975, and revised on August 27, 1976.[1] The impacts of the SO_2 regulations proposed originally and the revisions are analyzed separately in this report. Throughout this report, the terms "SO_2 regulations" and "regulations" refer only to the SO_2 regulations applicable to existing fossil-fuel generating stations.

The impacts of the SO_2 regulations are based primarily upon the results of EPA-sponsored research by three firms: 1) engineering cost studies of air pollution control equipment on Ohio power plants by PEDCO Environmental Specialists, Inc.; 2) least-cost optimization analysis to estimate compliance strategies by Energy and Environmental Analysis, Inc. (EEA); and 3) economic and financial evaluations based on those cost and compliance estimates by Temple, Barker & Sloane, Inc. (TBS).

Conclusions

The major conclusions in this report are presented below and summarized in Table 1. Unless otherwise noted, all costs are in constant 1975 dollars.

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[1] *The original and revised SO_2 regulations were published in the Federal Register, Volume 40, Number 217, November 10, 1975, and Volume 41, Number 168, August 27, 1976, respectively.*

Assuming implementation of the revised SO_2 regulations, the impact on the investor-owned electric utilities and their customers would be as follows:

- Average consumer charges and utility operating revenues would increase 2.9 percent in 1980 and 1.8 percent in 1985.[2] This would cause the average residential customer's monthly electric bill to increase $0.88 ($30.33 to $31.21) by 1980 and $0.68 ($37.57 to $38.25) by 1985. Including the effects of inflation, the increase would be $1.17 in 1980 and $1.13 in 1985.

- Annual operating and maintenance expense (including fuel) would increase about 1.1 percent in 1980 and 0.9 percent in 1985. The annual increase by 1985 will be $30.1 million.

- Capital expenditures (defined as cash outlays and allowance for funds used during construction (AFDC)), would increase by $542 million during the period 1976-1979. This is a 10.7 percent increase over the baseline capital expenditures of $5,081 million which will be required for this period in the absence of any SO_2 regulations.

- External financing required to support these capital expenditures would increase by $497 million over the original external financing requirement of $3,938 million for the period 1976-1979, a 12.6 percent increase.

---

[2] *The decreasing relative effect of the SO_2 expenditures is due to inflation and increasing costs of operating the utilities.*

- Of the eight major investor-owned utilities in Ohio, five could reasonably be expected to have little or no difficulty in obtaining financing for the equipment required by the revised regulations. Two of the utilities, Ohio Power and Ohio Edison, may have some difficulty obtaining debt financing but should be in a position to issue additional common stock to cover the cost, if necessary. One utility, Ohio Valley Electric, would not be affected by the revised regulations.

The impacts of the revised SO_2 regulations on the municipal and cooperative utilities in Ohio would be:

- Average consumer charges for municipal and cooperative customers (almost entirely residential) would increase by 2.9 percent in 1980 and 2.1 percent in 1985. The average monthly residential bill in 1980 would increase by $0.66, from $22.60 to $23.26.

- Capital expenditures would increase by $24.1 million and external financing requirements would increase by approximately $16.8 million over the period 1976-1979.

- Annual operating and maintenance costs would increase by $3.2 million per year.

Had the original proposed SO_2 regulations been implemented, the effect on investor-owned utilities would have been:

- Average consumer charges and utility operating revenues would have increased 7.9 percent in 1980 and 4.9 percent in 1985. The average residential customer's monthly electric bill would have increased $2.40 ($30.33 to $32.73) in 1980 and $1.83 ($37.57 to $39.40) in 1985. Including the effects of inflation, the increase would have been $3.19 in 1980 and $3.06 in 1985.

- Capital expenditures, including allowance for funds used during construction (AFDC), would have increased by $1,480 million during the period 1976-1979. This is a 29.1 percent increase over the capital expenditures of $5,081 million which will be required for this period if no SO_2 regulations are implemented.

- External financing required to support these capital expenditures would have increased by $1,347 million over the original external financing requirement of $3,938 million for the period 1976-1979--a 34.2 percent increase.

- Annual operating and maintenance expense (which includes fuel) would have increased about 3.2 percent by 1980 and 2.6 percent by 1985. The annual increase by 1985 would have been $86.1 million.

There is a substantial difference in the relative impacts of the revised SO_2 regulation and the original proposed regulation. As can be seen from the data in Table 1, the original regulation would have had about two and one-half times the impact of the revised regulation. For example, the increase in 1980 consumer charges due to the original regulation would have been 2.7 times the increase due to the revised regulation. Cumulative capital expenditures for SO_2 equipment would have been $938 million (2.7 times) larger under the original regulation than the revised regulation. Similar differences exist in external financing.

It should be noted that all capital expenditures required by either the original or the revised SO_2 regulations would be incurred prior to 1980. However, changes in operating costs resulting from the regulations would continue throughout the remaining lives of the generating equipment affected.

Table 1

IMPACT OF SO_2 REGULATIONS ON THE INVESTOR-OWNED OHIO ELECTRIC UTILITY INDUSTRY

(all figures in 1975 dollars)

		Baseline	Revised SO_2 Req's.	Original SO_2 Req's.
Consumer Charges	1976	$23.75	$23.77	$23.81
(mills/kwh)	1980	27.54	28.35	29.73
	1985	30.94	31.49	32.44
Operating Revenues	1976	$3,176	$3,178	$3,184
(millions of	1980	4,461	4,591	4,815
dollars)	1985	6,285	6,398	6,591
Average Monthly	1976	$23.55	$23.57	$23.59
Residential Bill	1980	30.33	31.21	32.73
(dollars)	1985	37.57	38.25	39.40
Capital Expenditures, 1976-1979 (millions of dollars)		$5,081	$5,623	$6,561
External Financing, 1976-1979 (millions of dollars)		$3,938	$4,435	$5,285

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These conclusions and the data and analysis supporting them are the subject of the following chapters. Chapter 2 covers the method of analysis employed and the scope of the study. Chapters 3 and 4 cover in detail the financial impacts of the revised and originally proposed SO_2 regulations, respectively. Appendix A contains summary financial data from which the conclusions were drawn. Appendix B contains the pollution control cost data supplied to TBS by EPA, PEDCO, and EEA for use in this analysis.

A separate Technical Appendix contains the full set of projections for each of the eight Ohio investor-owned utilities, the assumptions and data on which the projections were based, and a detailed description of the computerized model used in the study.

CHAPTER 2
METHODOLOGY AND SCOPE OF ANALYSIS

The methodology employed for this analysis is consistent with the national approach taken by EPA. Temple, Barker & Sloane, Inc. (TBS) performed the analysis for EPA's May 1976 report Economic and Financial Impacts of Federal Air and Water Pollution Controls on the Electric Utility Industry.[3]

To determine the impact of the SO_2 regulations on existing plants, financial projections for the Ohio electric utility industry were made assuming no EPA SO_2 regulations on existing plants. This projection does, however, include the expenditures to be made for pollution control equipment on future power plants (including compliance with particulate regulations, New Source Performance Standards, and effluent guidelines) and EPA estimates of expenditures to be made in bringing existing plants into compliance with particulate regulations and effluent guidelines. The financial condition of the Ohio electric utility industry assuming compliance with the SO_2 regulations by the end of 1979 was compared to the projections made assuming no SO_2 regulations to measure the impact of the regulations. The same analysis was performed for both the revised and the original regulations. Appendix B shows the pollution control equipment and operating costs used in the study.

TBS has used the same computerized Policy-Testing model (PTm) of the electric utility industry in this Ohio utility study as it used in the national study. The general approach to developing the industry projections has been to utilize the

[3] *Copies available from the National Technical Information Service, Springfield, Virginia 22151. (EPA-230/3-76-013)*

PTm model for the financial relationships and to rely upon individual utilities for the data and assumptions underlying the projections.

The PTm model for the electric utility industry contains forecasting relationships of energy requirements, capacity, and utilization at the company level. In this application, PTm takes as inputs each utility's projections of generation, peak load and capacity additions. It then forecasts operating expenses, revenues, financing requirements, and ultimately, consumer charges from 1976 to 1985.

There are three major areas of data requirements for PTm. The first area comprises detailed operating and financial statistics for the base year, 1975. These data were obtained from material supplied by the utilities. Second is a set of assumptions regarding future load growth and capacity additions and retirements. The data contained in each company's Ten Year Forecast Report to the Ohio Power Siting Commission were used to meet this requirement. Finally, PTm requires projections of a variety of economic and physical variables, including new plant costs (per kilowatt of capacity), fuel prices, interest rates, inflation rates, tax rates, heat rates, capacity factors, etc. Many of those items were available in the material supplied by each utility, and where available, were used in making the projections. Where such data were not provided by the company, TBS utilized estimates developed previously in TBS' analysis for EPA of the national impacts of pollution control regulations upon the electric utility industry. Capital and operating costs associated with each type of pollution control were provided by the EPA.

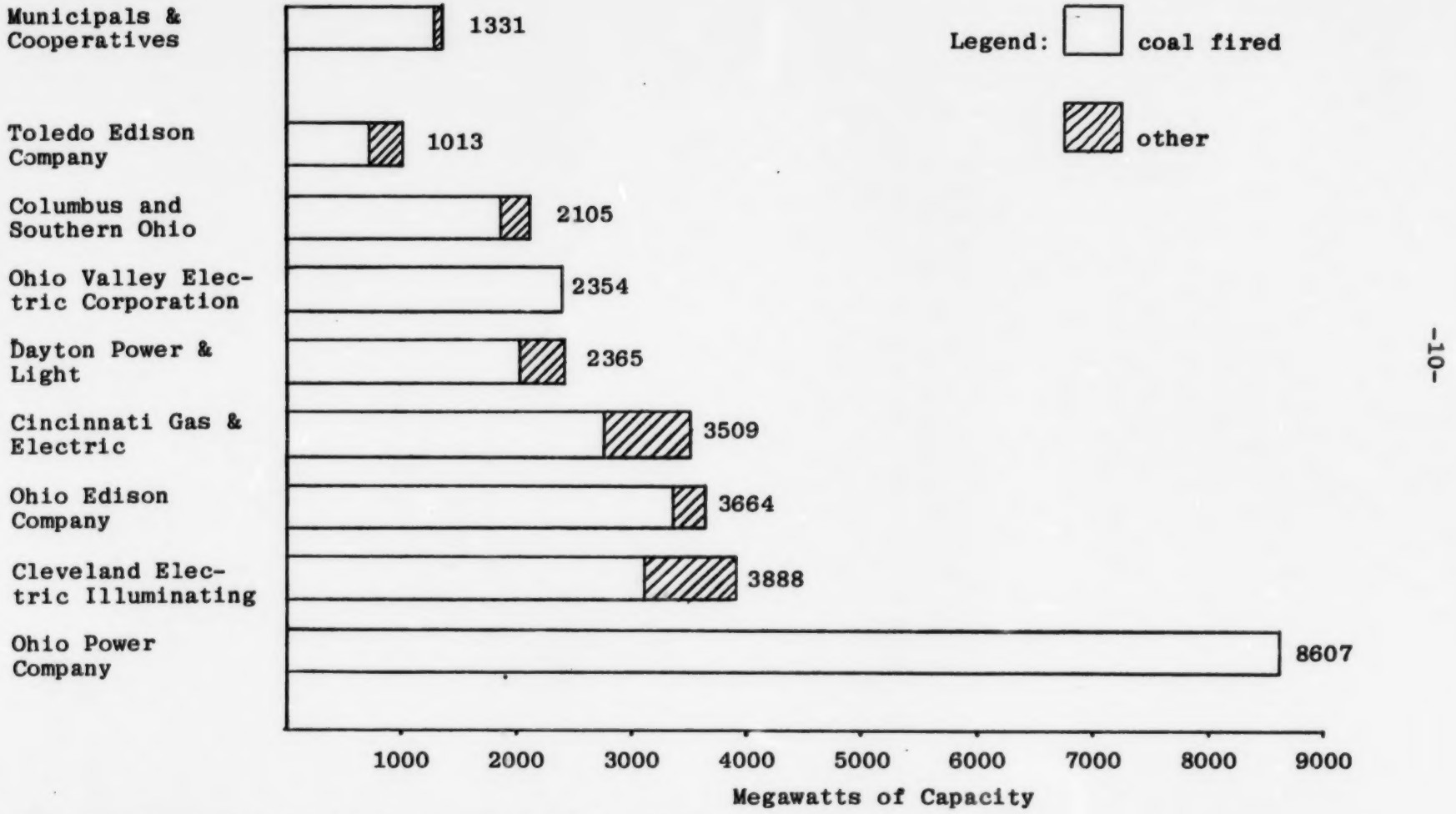
Due to the diversity in size and operating characteristics of the major electric utilities in Ohio, the impacts of the SO_2 regulations were determined on a company basis rather than a state-wide basis. There are eight major investor-owned electric utilities in Ohio. Together, they account for approximately 94 percent of the coal-fired electric production capacity (1975) and approximately 96 percent of the total power generated in Ohio (1974). The relative size of these utilities is shown in Figure 1 and Table 2. The majority of the power and generating capacity not furnished by these investor-owned utilities is provided by a number of municipal and cooperative utility systems. The municipal and cooperative systems are very small compared to the investor-owned companies. In 1975 their total coal-fired generating capacity was about 1,318 megawatts. The major investor-owned, municipal, and cooperative utilities are listed in Table 2.

A number of factors dictated that the analysis of the effects of the SO_2 regulations on the municipal and cooperative systems be performed on a composite basis; that is, the group of municipals and cooperatives be treated as one utility system. These factors were: 1) the relatively small size of each; 2) a general lack of accurate and timely financial and operating data; and 3) the relatively static nature of the municipals' operations (i.e., little growth in capacity).

When projecting the financial condition of each of the investor-owned utilities, the operation of existing plants and construction of new plants outside Ohio was included. The cost of pollution control equipment (PCE) being, or to be, installed on these plants and all new plants, both in and out of Ohio, was taken from utility sources, where available. EPA cost estimates for PCE were used only for existing plants in Ohio, bringing them in compliance with particulate regulations, effluent guidelines, and SO_2 regulations.

Figure 1

GENERATING CAPABILITY*
OF THE MAJOR OHIO ELECTRIC UTILITIES - 1975



Net summer generating capability of each utility. Includes generating capacity inside and outside of Ohio. These figures were used in making the projections in this analysis.

TABLE 2

STEAM-ELECTRIC PLANT CAPACITY[1] OF OHIO UTILITIES - 1974

Utility	Coal[2] Capacity (MW)	Total[3] Capacity (MW)	Generation[4] (million kwh)	Capitalization (millions of $)
Investor-Owned				
Cincinnati Gas & Electric	1826.9	2333.8	6662.5	$1088.5
Cleveland Electric Illuminating	3686.2	3686.2	19246.9	1263.1
Columbus and Southern Ohio	1677.8	1677.8	7874.1	781.8
Dayton Power and Light	3303.4	3303.4	12860.0	798.9
Ohio Edison	3756.0	3756.0	18164.1	1576.7
Ohio Power	5508.9	5508.9	14839.2	2143.7
Ohio Valley Electric	1086.3	1086.3	8045.0	127.9
Toledo Edison	947.0	947.0	5220.7	665.5
Total Investor Owned	21792.5	22299.4	92912.5	
Municipals and Cooperatives				
Buckeye Power	615.0	615.0	2824.0	
Cleveland	160.0	160.0	171.6	
Columbus	39.5	52.5	107.1	
Dover	35.9	35.9	74.9	
East Palestine	16.5	16.5	31.8	
Hamilton	133.5	133.5	234.4	
Napoleon	23.7	23.7	59.0	
Orrville	108.5	108.5	144.0	

Utility	Coal[2] Capacity (MW)	Total[3] Capacity (MW)	Generation[4] (million kwh)
Painesville	63.0	63.0	128.9
Piqua	54.8	54.8	161.0
Reading	15.3	15.3	55.6
St. Mary's	12.5	12.5	22.5
Shelby	40.0	40.0	63.7
Total Municipals and Cooperatives	1318.2	1331.2	4078.5
Total Ohio	23110.7	23630.6	96991.0

[1] *Capacity and generation of jointly-owned plants is listed only under the company which operates the plant, not the companies which share ownership. This chart is intended only for showing the relative size of investor-owned, municipal, and cooperative utilities. The definition of capacity is different from that used in Figure 1. These numbers were not used in making the projections in this analysis.*

[2] *Total coal-fired steam-electric capacity located in Ohio, 1975.*

[3] *Total steam-electric capacity located in Ohio, 1975.*

[4] *Total generation of steam-electric plants located in Ohio, 1974.*

[5] *Capitalization as of December 31, 1975, except Ohio Power (June 30, 1975).*

Source: Steam-Electric Plant Factors, 1975, National Coal Association

Four sets of projections were made for each company. The first was the baseline, which included no expenditures for pollution control equipment for existing plants, but did include PCE costs for new plants. The second projection added to the baseline expenditures those PCE expenditures necessary to bring existing plants into compliance with particulate and effluent guidelines (TSP and water). The third and fourth projections added the expenditures for SO_2 control required by the original regulations, and the revised regulations, respectively, to the expenditures included in the second projection. When measuring the effects of the SO_2 regulations, the third and fourth projections were compared with the second.

A number of assumptions were made when making these projections which affect the impact of the SO_2 regulations. These assumptions were:

- Interest rates on capital required for future expenditures were held constant at a level near the rate each Ohio utility now pays for new capital.
- Each utility realizes a 14 percent rate of return on equity (in 1975, actual rate of return ranged from 10 to 14.3 percent).
- No plants were retired as a result of the issuance of the SO_2 regulations.

Additional detail on the assumptions made for each company appears in the Technical Appendix.

Each of the eight investor-owned utilities was given the opportunity to review and comment on the initial baseline projections. As a result of this review process, a number of changes and corrections were made at the utilities' request.

CHAPTER 3

FINANCIAL IMPACT OF THE REVISED SULFUR DIOXIDE REGULATIONS

The economic impact of the revised sulfur dioxide (SO_2) regulations on the Ohio electric utility industry and its customers will be evident in a number of areas. These are:

- consumer charges and operating revenues,
- average residential electric bill,
- operation and maintenance expenses,
- capital expenditures requirements, and
- external financing requirements.

The regulations will effect both investor-owned and municipal and cooperative systems in these areas. These effects were summarized in Chapter 1 and are covered in more detail below.

Consumer Charges and Operating Revenues

For consumers of electricity, the most meaninful measure of the effect of implementing the revised SO_2 regulations is the increase in annual costs which results. The total annual cost of SO_2 control is equivalent to the increased revenues which would have to be collected by the electric utilities from their customers to cover their increased costs. The required revenues would increase because

of increased operating and maintenance costs, fuel premiums, interest charges, depreciation charges, and income and property taxes. The increase in operating revenues required in any given year is the cost of SO_2 control for that year.

It is also meaningful to look at the increase in operating costs on a per kilowatt-hour basis. Consumer charges are defined as the annual operating revenues divided by the kilowatt-hour sales for that year. The increase in consumer charges due to the SO_2 regulations is the increase in cost of each kilowatt-hour of electricity sold.

Figure 2 shows the consumer charges (in constant 1975 dollars) for each of the eight investor-owned utilities studied, for the years 1976, 1980, and 1985. In 1976, the impact of the revised SO_2 regulations is hardly measurable. The effect would be most pronounced in 1980, ranging across utility systems from no increase to a 6.6 percent increase in consumer charges and averaging 2.9 percent. By 1985, the relative effect of the SO_2 regulations (i.e., as a percent of consumer charges) would decrease due to the increase in other charges resulting from the construction of new plants and increased fuel prices.

Figure 3 shows the operating revenues for each company for the same periods covered by Figure 2. The increases which would result due to SO_2 control on a percentage basis are the same as for consumer charges, except for slight variations due to rounding error.

FIGURE 2

PROJECTED CONSUMER CHARGES FOR ELECTRICITY
REVISED SO_2 REGULATIONS

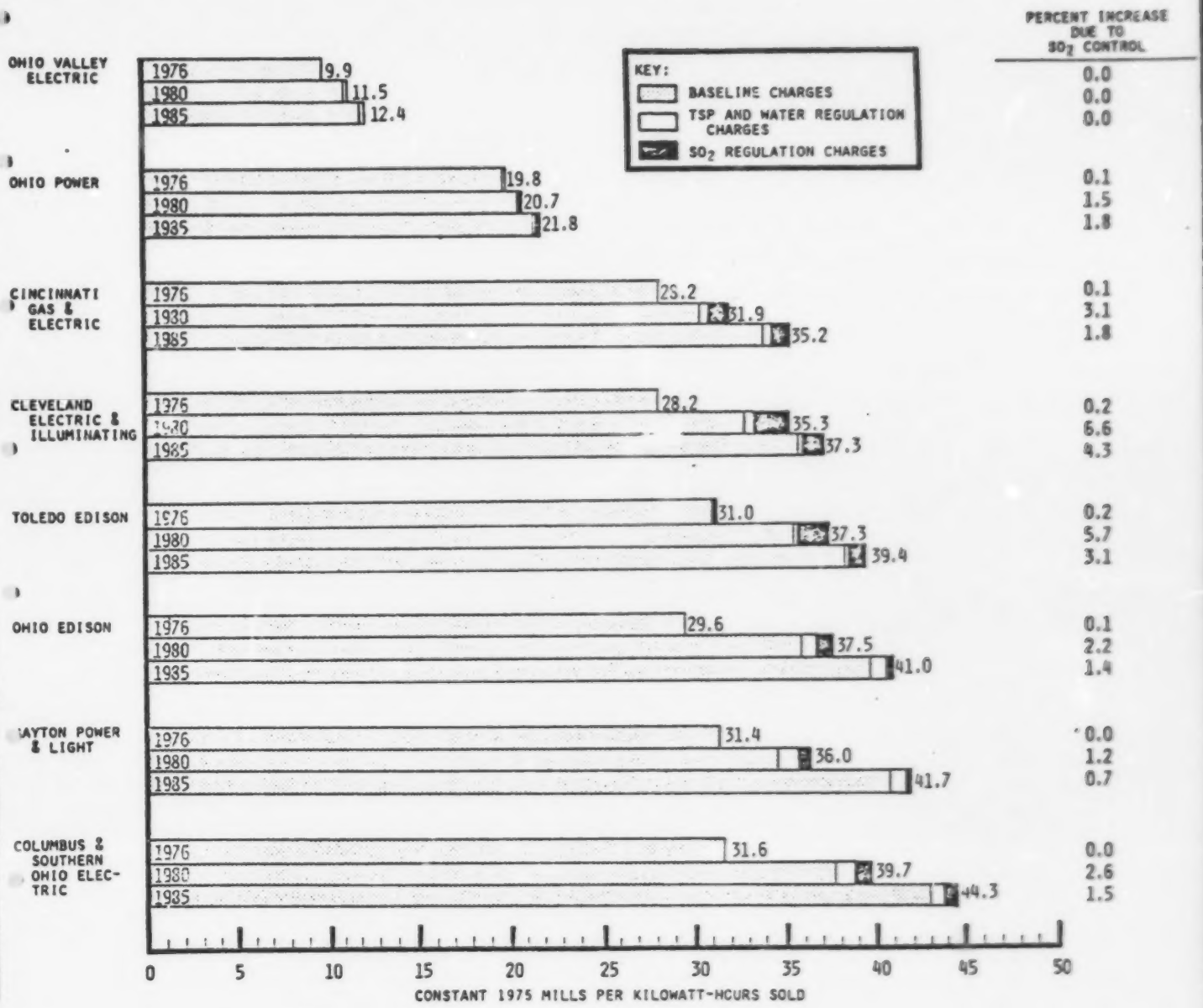
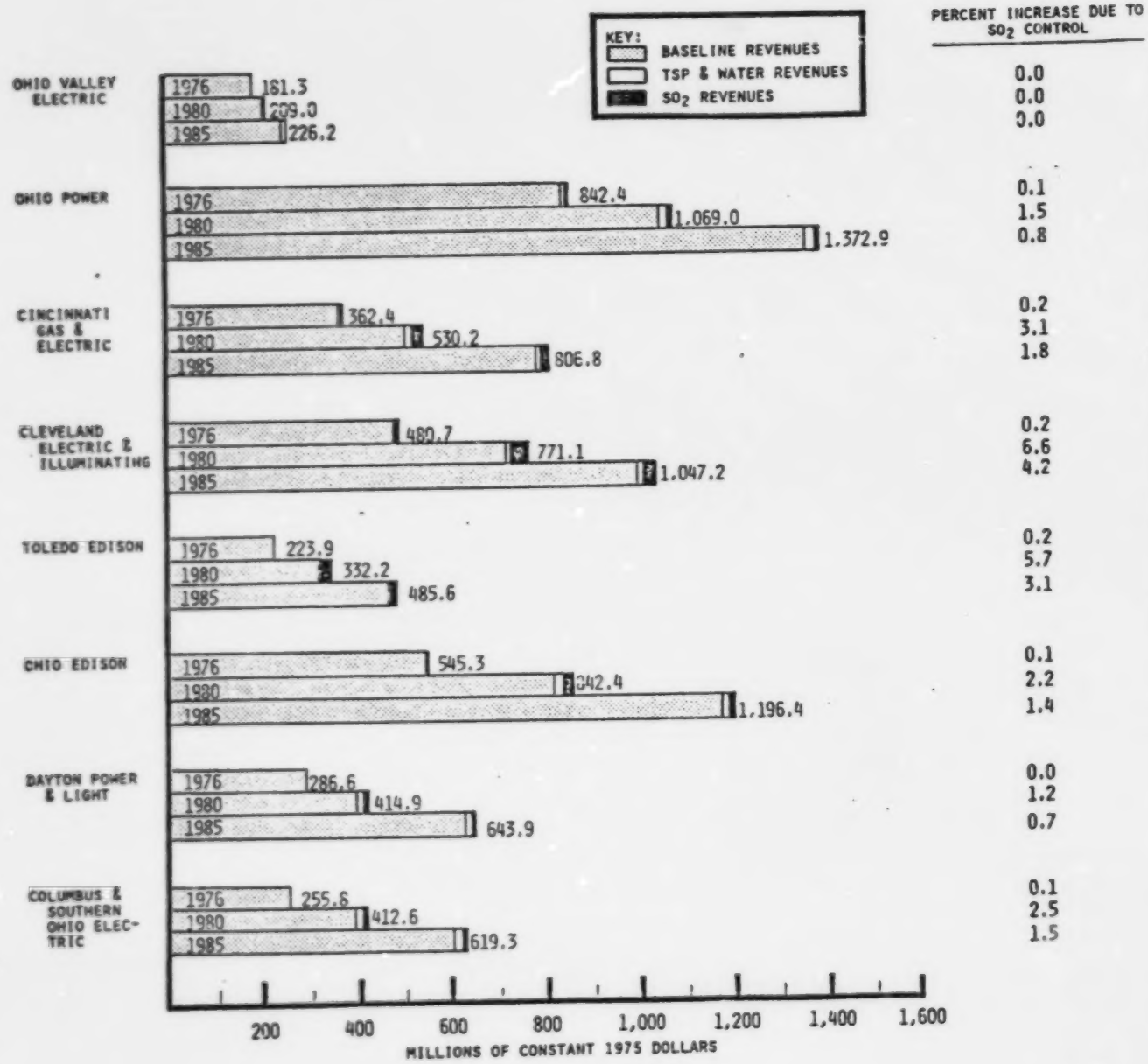


FIGURE 3

PROJECTED REQUIRED ELECTRIC OPERATING REVENUES
REVISED SO_2 REGULATIONS



Even without SO_2 control on existing plants, there will be a substantial rise in consumer charges and operating revenues in constant dollars (about 15.5 percent) in the period 1976 to 1980. This will be due to the increase in fuel prices and new plant construction costs over and above the rate of inflation, and to the construction of other pollution control equipment required by existing regulations.

Average Residential Electric Bill

To put the increases in consumer charges and operating revenues due to SO_2 control in another perspective, the impact on the average residential customer's monthly bill has been calculated. To perform this calculation, some assumptions were made:

- Average electricity usage per residential customer will increase at an annual rate equal to the projected average annual rate in the East North Central Census Region (3 percent per year between 1976 and 1980 and 2.5 percent per year between 1981 and 1985).
- Residential rates will remain about 50 percent higher than the average rate per kilowatt-hour.

The average 1976 monthly residential customer electric bill of $23.55 will increase to $30.33 in 1980 and $37.57 in 1985 without any SO_2 control expenditure. The revised SO_2 regulations would cause the 1980 monthly bill to increase $0.88 (2.9 percent) and the 1985 monthly bill to increase $0.68 (1.8 percent) in constant dollars. The constant dollar increase would be less in 1985 than in 1980 because capital-related charges (i.e., interest and depreciation) are fixed in undeflated dollars and therefore decrease over time in constant dollars.

Operation and Maintenance Expenses

The revised SO_2 regulations would affect the operating and maintenance expenses of Ohio utilities in three ways. First, there would be the additional operating and maintenance expense associated with the operation of the pollution control equipment. Second, the operation of the additional capacity built to replace the derated capacity would increase operation and maintenance expenses. Third, any premium paid for low-sulfur fuels necessary to comply with the SO_2 regulations would be reflected in the operation and maintenance costs.

Figure 4 shows the operation and maintenance expenses per kilowatt-hour sold of each of the investor-owned utilities in Ohio for 1976, 1980, and 1985. For some companies the cost per kilowatt-hour sold decreased over one or more of the periods shown. This is due to the addition of large amounts of nuclear generating capacity in the future. The nuclear capacity has lower fuel costs than coal capacity, and this is reflected in Figure 4. (Nuclear capacity does have a higher initial capital cost than coal capacity which offsets some of the fuel savings.)

Under the revised regulations the increase in operation and maintenance expenses due to SO_2 control on existing plants ranged from 0 to 3 percent and averaged 1.1 percent in 1980. In 1985 the range of increase was from 0 to 2.3 percent with an average increase of 0.9 percent. Total operation and maintenance expenses for 1980 and 1985 are projected to be $2,602 million and $3,377 million, respectively.

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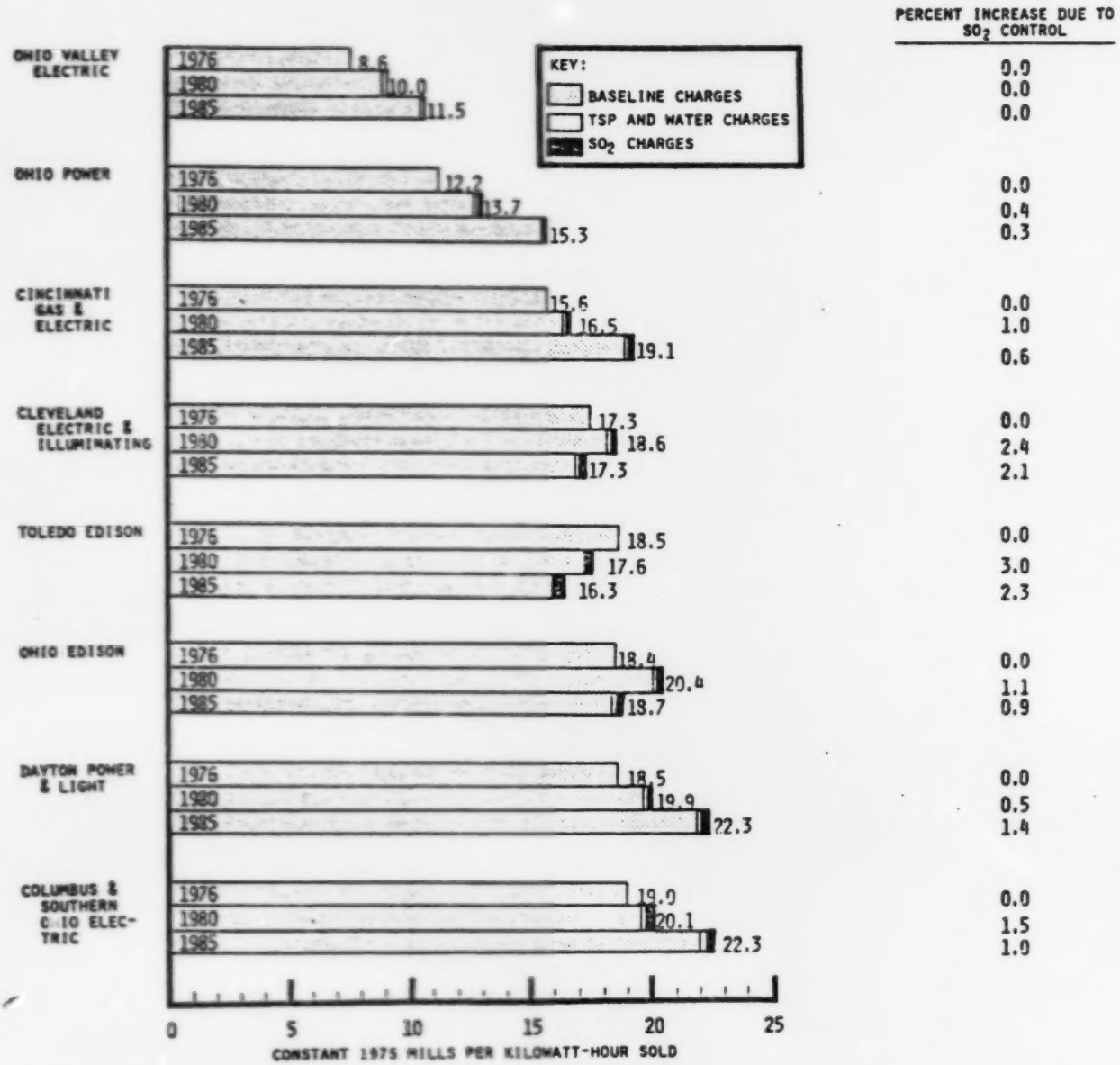
FIGURE 4

PROJECTED OPERATION AND MAINTENANCE COSTS (PER KILOWATT-HOUR)
REVISED SO_2 REGULATIONS



Capital Expenditure Requirements

While the impact of the revised SO_2 regulations on the Ohio electricity consumer is most clearly shown by the change in consumer charges, the impact on the electric utility industry is most evident in the increase in capital expenditure requirements.

Figure 5 shows each investor-owned utility's capital expenditures for the period 1976-1979. (Since the revised SO_2 regulations require compliance prior to the end of 1979, it has been assumed that all capital expenditures made in compliance with the regulations will be made prior to 1980.) The expenditures shown as being required for the SO_2 regulations consist of expenditures for pollution control equipment (scrubbers, precipitators, blending equipment, etc.) as well as for replacing capacity which was derated as a result of the installation of the pollution control equipment or the use of low sulfur coal.

As a percent of other capital expenditures, the SO_2 expenditures range from 0 to 23 percent across utility systems and average 10.6 percent. During that period, the total capital expenditures for all companies will be $5,031 million for non-$SO_2$ items and $542 million for SO_2 control.

Figure 6 shows the level of these expenditures by year. The revised SO_2 regulations would cause an increase in capital expenditures for the years 1976, 1977, 1978, and 1979 of 6.1, 12.4, 15.2, and 7.5 percent, respectively.

FIGURE 5

PROJECTED CUMULATIVE CAPITAL EXPENDITURES
JANUARY 1, 1976-DECEMBER 31, 1979
REVISED SO_2 REGULATION

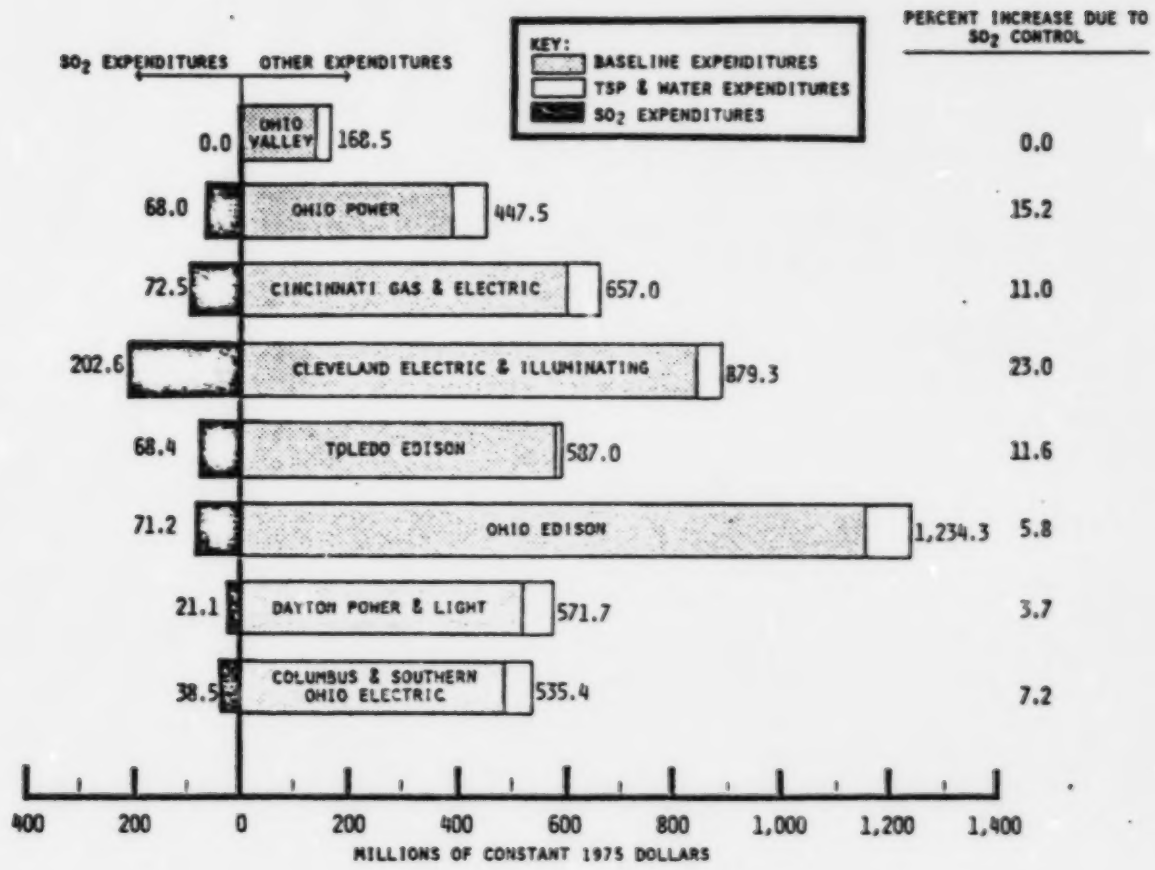
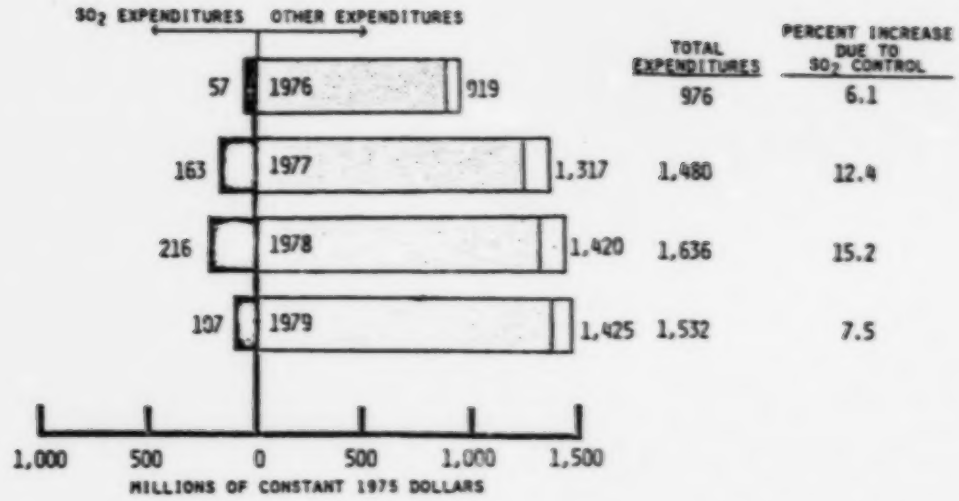
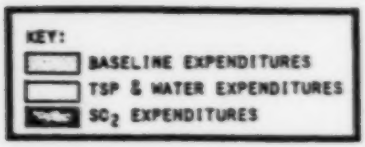


FIGURE 6

PROJECTED ANNUAL CAPITAL EXPENDITURES
OHIO INVESTOR-ONCIED ELECTRIC UTILITIES
REVISED SO_2 REGULATIONS



	TOTAL EXPENDITURES	PERCENT INCREASE DUE TO SO_2 CONTROL
1976	976	6.1
1977	1,480	12.4
1978	1,636	15.2
1979	1,532	7.5



External Financing Requirements

The impact on external financing requirements, that is, the amount of capital which must be raised through the issuance of debt or stock closely parallels the impact of the SO_2 regulations on capital expenditures.

The cumulative external financing requirements for the period 1976-1979 for each Ohio investor-owned utility are shown in Figure 7. The annual level of combined external financing requirements for all the utilities is shown in Figure 8. The revised SO_2 regulations would cause an increase in external financing requirements for the years 1976, 1977, 1978, and 1979 of 10.0, 15.0, 20.2, and 5.1 percent, respectively. The total external financing requirements for the period 1976-1979 are $3,938 million for non-$SO_2$ items and $497 million for SO_2 control.

To determine the ability of Ohio investor-owned utilities to finance the SO_2 removal equipment required by the revised regulations, each utility's capacity for issuing additional long-term debt and common equity was examined. While a utility's ability to raise capital is dependent on many factors, this analysis focused on two of the more important factors: debt coverage ratios and market-to-book stock price ratios. These two ratios, while somewhat limited, provide the best direct indications of a utility system's financing strength.[4]

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[4] *For a fuller discussion of coverage ratios and market-to-book ratios, see the report prepared by TBS for EPA, Economic and Financial Impacts of Federal Air and Water Pollution Controls on the Electric Utility Industry, May 1976, pages IV-71 to 78 and IV-121 to 127.*

FIGURE 7

PROJECTED CUMULATIVE EXTERNAL FINANCING REQUIREMENTS
JANUARY 1, 1976-DECEMBER 31, 1979
REVISED SO_2 REGULATION

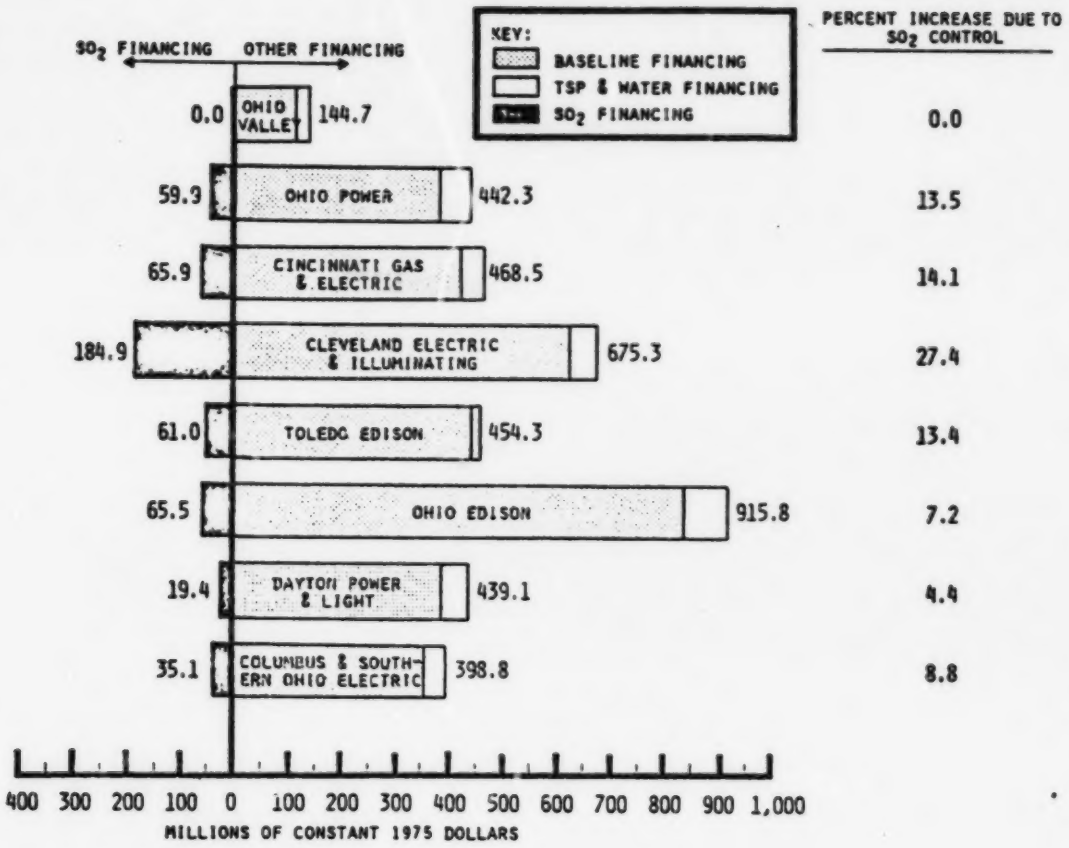
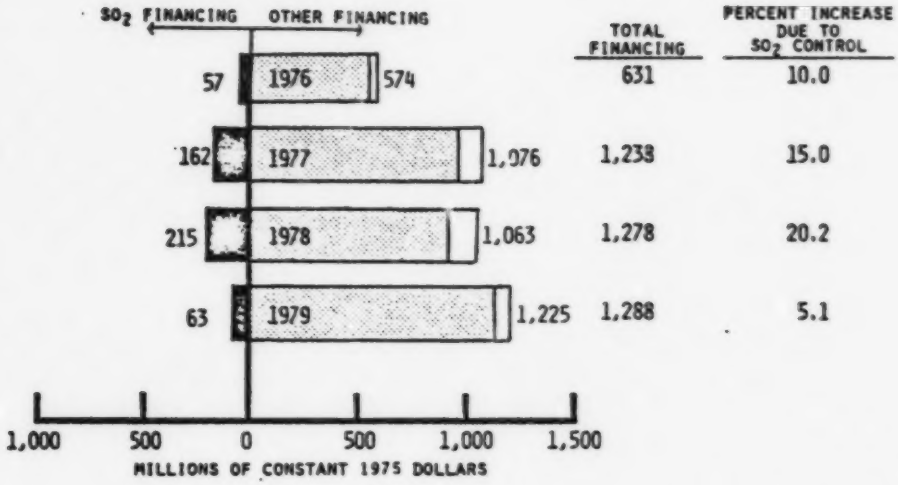
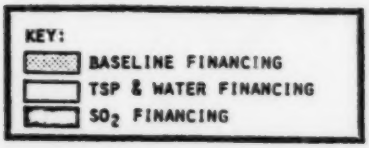


FIGURE 8

PROJECTED ANNUAL EXTERNAL FINANCING REQUIREMENTS
OHIO INVESTOR-OWNED ELECTRIC UTILITIES
REVISED SO_2 REGULATIONS



	TOTAL FINANCING	PERCENT INCREASE DUE TO SO_2 CONTROL
1976	631	10.0
1977	1,238	15.0
1978	1,278	20.2
1979	1,288	5.1



The coverage ratio is a measure of a company's capacity to raise additional long-term debt. It is the ratio of net earnings before interest and taxes to long-term debt interest, and must legally be at or above a prespecified level for a utility to issue additional long-term debt. For the Ohio utilities, that level is set at 2.0 in the Indenture Agreements for their outstanding bonds.

The market-to-book ratio, on the other hand, is a measure of a company's ability to sell common stock at an economic price. When the market price of stock falls below the book price, (i.e., market-to-book ratio below 1.00) sales of additional common stock dilute the holdings of existing stockholders. For that reason selling common stock below book value is undesirable to the stockholders and avoided by the companies as much as possible.

In this analysis the present coverage ratios, bond ratings, and market-to-book ratios were obtained in order to assess each company's current financial strength. In addition, the future prospects for each company were estimated by computing coverage ratios for the years 1976-1979 on the basis of the projections described earlier. Those computations were performed under several different assumptions: first, for the baseline case; second, including the additional expenditures required to meet the revised regulations financed with the company's baseline mix of debt and equity; and third, including the additional expenditures financed completely with debt (because for some companies the increased expenditure is small relative to other expected financing). All of these computations were based upon the companies' historical rates of return on equity for the 1972-1975 period in order to be

conservative. These current and projected figures then served as indicators of each company's financial position and were the basis for the conclusions described below.

Although the revised SO_2 regulations would increase the capital expenditures and external financing requirements of seven of the eight investor-owned utilities studied (Ohio Valley Electric would not be affected), five of those seven should experience little or no difficulty in raising the capital required. Those five are:

- Cincinnati Gas and Electric
- Cleveland Electric Illuminating
- Columbus and Southern Ohio
- Dayton Power and Light
- Toledo Edison

These companies are now, and are projected to be, in a financial position which should enable them to finance the required SO_2 equipment by issuing additional long-term debt and/or common equity. Each is discussed briefly below.

Cincinnati Gas and Electric appears to be able to issue additional debt to cover its SO_2-related external financing requirement of $65.9 million. Based on the financial projections made in the study, the company's coverage ratio of 2.8 (October 1975) will decline somewhat by 1979, even in the absence of the SO_2 expenditures, because interest rates are expected to remain high for utilities. Even so, its coverage ratio is not expected to drop below 2.3 by 1979. The additional

debt required by the SO_2 expenditures would only account for another drop of 0.05, so debt financing could be expected to be available. With a current Moody rating of Aa, the bonds should also carry reasonable interest rates. In addition, financing part of the expenditures with equity would also seem feasible, with the stock currently selling slightly higher than the last reported book value of $17.75 (December 31, 1975).[5]

Although Cleveland Electric Illuminating has the largest SO_2 expenditures of the Ohio utilities, $202 million, it also appears to be in a position to finance them through a combination of long-term debt and equity. Cleveland's high coverage ratio (3.2 as of September 30, 1975) is projected to remain above 3.0 from 1976 to 1979, before considering the SO_2 expenditures. Even when the SO_2 financing is included at the company's baseline mix of debt and equity, the coverage ratio should not drop below 2.8 in that period, keeping the company comfortably above the minimum ratio of 2.0. In addition, the company's current bond rating of Aa (Moody's) and relatively high average rate of return on equity (14 percent in the 1972-1975 period) enhance its ability to issue additional debt. Cleveland's current common stock price of $28.50 (August 26, 1976) is above its 1975 year-end book value of $24.29, which makes equity financing appear feasible as well.

Columbus and Southern Ohio's coverage ratio of 2.6 (September 1975) is not projected to fall below 2.4 in any year during the 1976-1979 period, in the absence of the SO_2

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[5] *This and all subsequent book values of stock were obtained from Solomon Brothers, "Electric Utility Common Stock Market Data," May 1976.*

expenditures. The SO_2-related external financing requirement of $35.1 million for this period should not lower the coverage ratio by more than 0.09 even assuming the financing was completely with long-term debt. Equity financing also appears feasible, assuming the current market price of stock is maintained. The market price is now $24.38, virtually equal to the 1975 book value of $24.31.

Dayton Power and Light's mid-1975 coverage ratio of 2.7 is expected to drop to about 2.15 by 1979, before considering SO_2 expenditures. While this would indicate that Dayton Power and Light is reaching the limits of its debt capacity, the relatively small amount of financing needed for SO_2 equipment, $19.4 million, should have no appreciable impact on the company's coverage ratios. The system's baseline financing requirements, by comparison, are projected to be $439 million in the 1976-1979 period. Dayton Power and Light's common stock is currently selling for slightly more than its 1975 book value of $18.15, which would indicate that if the price of the stock does not decrease, equity financing is feasible.

Toledo Edison's year-end 1975 coverage ratio of 2.35 is projected to hit a low of 2.25 in 1977 and then increase to 2.6 by 1979. Even if the SO_2 financing requirements of $61 million are assumed to be financed entirely with debt, that coverage ratio should not decrease by more than about 0.1, indicating that debt financing seems available to the company. It would also appear feasible to provide some of the financing in the form of common equity if the current stock price is maintained. The 1975 book value of stock is $22.39, and the current market price is $24.00.

Two of the Ohio utilities, Ohio Edison and Ohio Power, might have difficulty in financing the SO_2-related capital expenditures. Both companies have coverage ratios near 2.0, and are not projected to improve this ratio substantially by 1979.

While Ohio Edison's ability to raise additional debt financing may be limited, the amount required for SO_2 equipment, $65.5 million, is small in comparison to its other financing needs for 1976-1979 of $915.8 million. If it is not possible to obtain sufficient additional debt financing for the SO_2 equipment, a major portion of the financing appears possible with common equity. Ohio Edison's common stock is currently selling well above its 1975 book value of $15.39. Assuming the market price of $18.13 (August 26, 1976) holds, equity financing would appear to be feasible. Additional common equity on the order of $65.5 million over a four-year period would not significantly alter the capital structure of this company, whose capitalization exceeds $1.6 billion. Alternatively, in light of the magnitude of its baseline capital expenditure program, it seems possible that Ohio Edison could reschedule its other capital expenditures in order to free up financing for some or all of the SO_2 equipment.

Ohio Power's financing difficulties appear to be the most severe of the Ohio utilities. While the amount of SO_2-related financing in relationship to other financing requirements is almost the same as for Cincinnati Gas and Electric and Toledo Edison, Ohio Power's financial condition is much more constrained. With a Moody's rating of Baa and future financing requirements which should keep the coverage

ratio very close to 2.0, Ohio Power's ability to raise additional debt is extremely limited. As in the case of Ohio Edison, however, equity financing could offer a possible solution. American Electric Power, which owns Ohio Power, had a market-to book ratio of 1.03 in May 1976. Since then the stock price has increased slightly. One cannot guarantee the continuation of that level, but at this point it does appear possible to finance the SO_2 expenditures in whole or in part through common equity.

A recent development which is not reflected in this analysis is Ohio Power's recent announcement of the pending closure of two power plants. If that happens and the cost of installing SO_2 equipment at those two plants is excluded, the company's SO_2 expenditures will decrease from $68 million to about $5 million. Even in its current financial condition, Ohio Power can reasonably be expected to be able to finance that reduced level of expenditures.

The financial indicators on which the above analyses were based, coverage ratios and market-to-book stock price ratios, are sensitive to changes in a number of factors. A significant change in any one of them could alter the conclusions above. These factors include:

- realized rate of return on common equity,
- market price of common stock,
- long- and short-term debt interest rates,
- capital project construction schedules, and
- addition and elimination of capital construction projects.

Impacts on Municipal and Cooperative Utilities

Due to the small size of the individual municipal and cooperative utilities in Ohio, it is difficult to make projections of their future operating and financial condition with a high degree of accuracy. A number of strategic assumptions must be made when analyzing the effect of the SO_2 regulations on them. These assumptions are based on historical data and may or may not prove to be true in the future. The assumptions used in this analysis are:

- The municipal and cooperatives maintain their 1974 share of total generation (4.2 percent)[6] and portion of purchased power (13.4 percent) in the future.
- The increase in average consumer charges (aside from that which arises from the SO_2 regulations) is at the same rate as for the investor-owned utilities.
- The price the municipals and cooperatives pay for purchased power increases at the same rate as investor-owned utilities' generating costs when SO_2 control is included.
- Approximately 70 percent of the capital which would be required to meet the SO_2 standards is financed externally.

The major effect of the revised SO_2 regulations on the municipal and cooperative utilities is an increase in capital expenditures between 1976 and 1979 of $24.1 million and about $3.2 million a year in increased operating and

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[6] *The historic data used for the municipal and cooperative utility analysis were obtained from the 1974 Statistical Year Book, published by the Edison Electric Institute, and the National Coal Association's 1974 Steam Plant Factors.*

maintenance expenses after 1979. On an annual basis, this amounts to an increase in operating costs of $5.75 million. In 1980 and 1985 municipal and cooperative generation is estimated to be 7,258 and 9,177 million kilowatt-hours, respectively. The average cost per kilowatt-hour sold is estimated to be 26.85 mills in 1980 and 30.13 mills in 1985, without any SO_2 control. The increase in cost due to SO_2 control would be 0.79 (2.9 percent) in 1980 and 0.63 mills (2.1 percent) in 1985.

In the absence of SO_2 control, the average monthly residential bill is estimated to be $22.60 in 1980 and $28.00 in 1985. The increase in the average monthly bill due to SO_2 control would be $0.66 per month in 1980 and $0.58 per month in 1985.

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CHAPTER 4
FINANCIAL IMPACT OF THE ORIGINALLY PROPOSED SULFUR DIOXIDE REGULATIONS

The impacts of the originally proposed sulfur dioxide regulations on the Ohio electric utility industry and its customers will be covered briefly in this chapter. Since the areas of impact were explained in Chapter 3 and apply here, only the actual numeric impacts will be discussed.

Consumer Charges and Operating Revenues

Figure 9 shows the increase in consumer charges (in constant 1975 dollars), for each of the eight investor-owned utilities studied, for the years 1976-1980 and 1985. In 1976 the impact of the revised SO_2 regulations would have been hardly measurable. The effect would have been most pronounced in 1980, ranging across utility systems from an 0.9 to an 11.3 percent increase in consumer charges and averaging 7.9 percent. By 1985 the effect of the SO_2 regulations as a percent of consumer charges would have decreased due to the increase in consumer charges from the construction of new plants and increased fuel prices, except for slight variations due to rounding error.

Figure 10 shows the operating revenues for each company for the same periods covered by Figure 9. The increases due to SO_2 control on a percentage basis are the same as for consumer charges.

FIGURE 9

PROJECTED CONSUMER CHARGES FOR ELECTRICITY
ORIGINAL PROPOSED SO_2 REGULATIONS

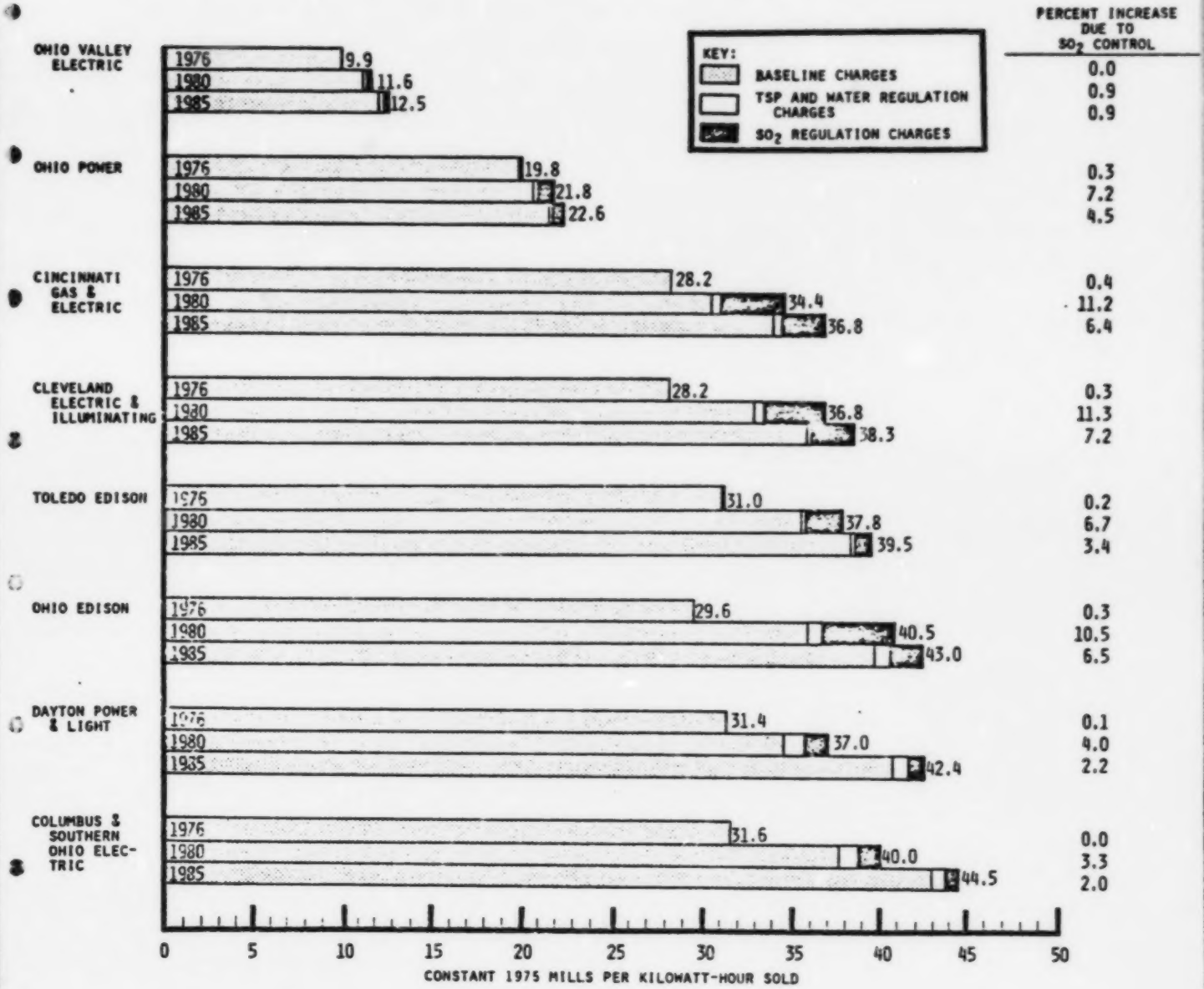
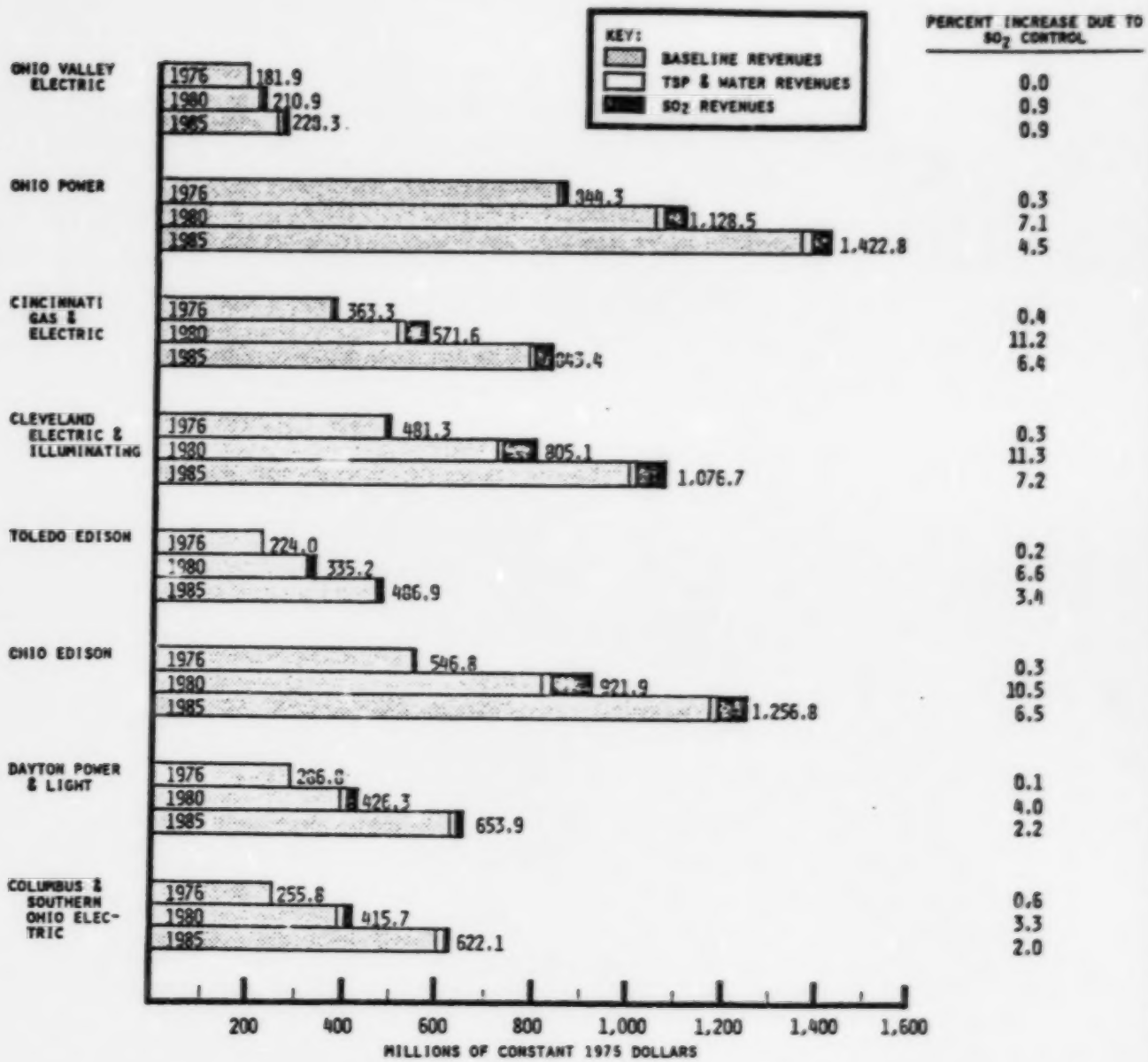


Figure 10

PROJECTED REQUIRED ELECTRIC OPERATING REVENUES
ORIGINAL PROPOSED SO_2 REGULATIONS



Average Residential Electric Bill

The average 1976 monthly residential customer electric bill of $23.55 will increase to $30.33 in 1980 and $37.57 in 1985 without any SO_2 control expenditure. The original SO_2 regulations would have caused the 1980 monthly bill to increase $2.40 (7.9 percent) and the 1985 monthly bill to increase $1.83 (4.9 percent) in constant dollars. The constant dollar increase is less in 1985 than in 1980 because capital-related charges (i.e., interest and depreciation) are fixed in undeflated dollars and therefore decrease over time in constant dollars.

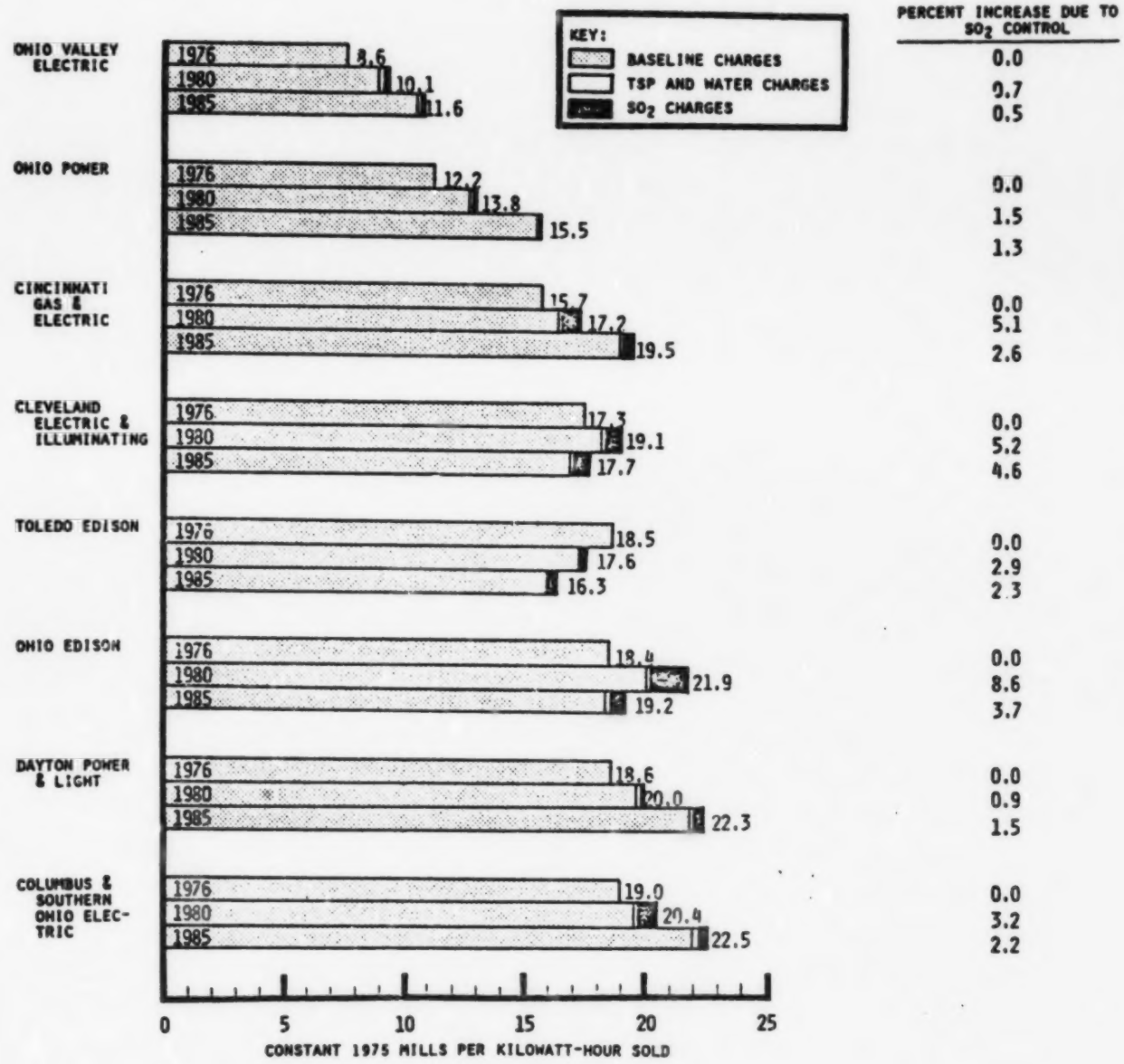
Operation and Maintenance Expenses

Figure 11 shows the operation and maintenance expenses of each of the investor-owned utilities in Ohio for 1976, 1980, and 1985, per kilowatt-hour sold. For some companies the cost per kilowatt-hour sold decreased over one or more of the periods shown. This is due to the addition of large amounts of nuclear generating capacity in the future. The nuclear capacity has lower fuel costs than coal capacity, and this is reflected in Figure 11. (Nuclear capacity does have a higher initial capital cost than coal capacity which offsets some of the fuel savings.)

The increase in operation and maintenance expenses due to SO_2 control on existing plants would have ranged between 0.7 and 8.6 percent and would have averaged 3.2 percent in 1980. In 1985 the range of increase would have been from 0.5 to 4.6 with an average increase of 2.6 percent. Total operation and maintenance expenses for 1980 and 1985 would have been $2,656 million and $3,432.6 million, respectively.

FIGURE 11

PROJECTED OPERATION AND MAINTENANCE COSTS (PER KILOWATT-HOUR)
ORIGINAL PROPOSED SO_2 REGULATIONS



Capital Expenditure Requirements

Figure 12 shows each investor-owned utility's capital expenditures for the period 1976-1979. (Since the original SO_2 regulations would have required compliance prior to the end of 1979, it has been assumed that all capital expenditures made in compliance with the regulations would be made prior to 1980.) The expenditures shown as being required for the SO_2 regulations consist of expenditures for pollution control equipment (scrubbers, precipitators, blending equipment, etc.) as well as for replacing capacity which was derated as a result of the installation of the pollution control equipment or use of low sulfur coal.

As a percent of other capital expenditures, the SO_2 expenditures would have ranged from 5.6 to 86.0 percent across utility systems, and averaged 29.1 percent. During that period, the total capital expenditures for all companies would have been $5,081 million for non-$SO_2$ items and $1,480 million for SO_2 control.

Figure 13 shows the level of these expenditures by year. The original SO_2 regulations would have caused an increase in capital expenditures for the years 1976, 1977, 1978, and 1979, of 16.7. 33.8. 41.6. and 20.5 percent. respectively.

External Financing Requirements

The cumulative external financing requirements for the period 1979-1979 for each utility are shown in Figure 14, and the annual level of combined external financing requirements for all the investor-owned utilities in Ohio is shown in Figure 15.

FIGURE 12

PROJECTED CUMULATIVE CAPITAL EXPENDITURES
JANUARY 1, 1976-DECEMBER 31, 1979
ORIGINAL PROPOSED SO_2 REGULATION

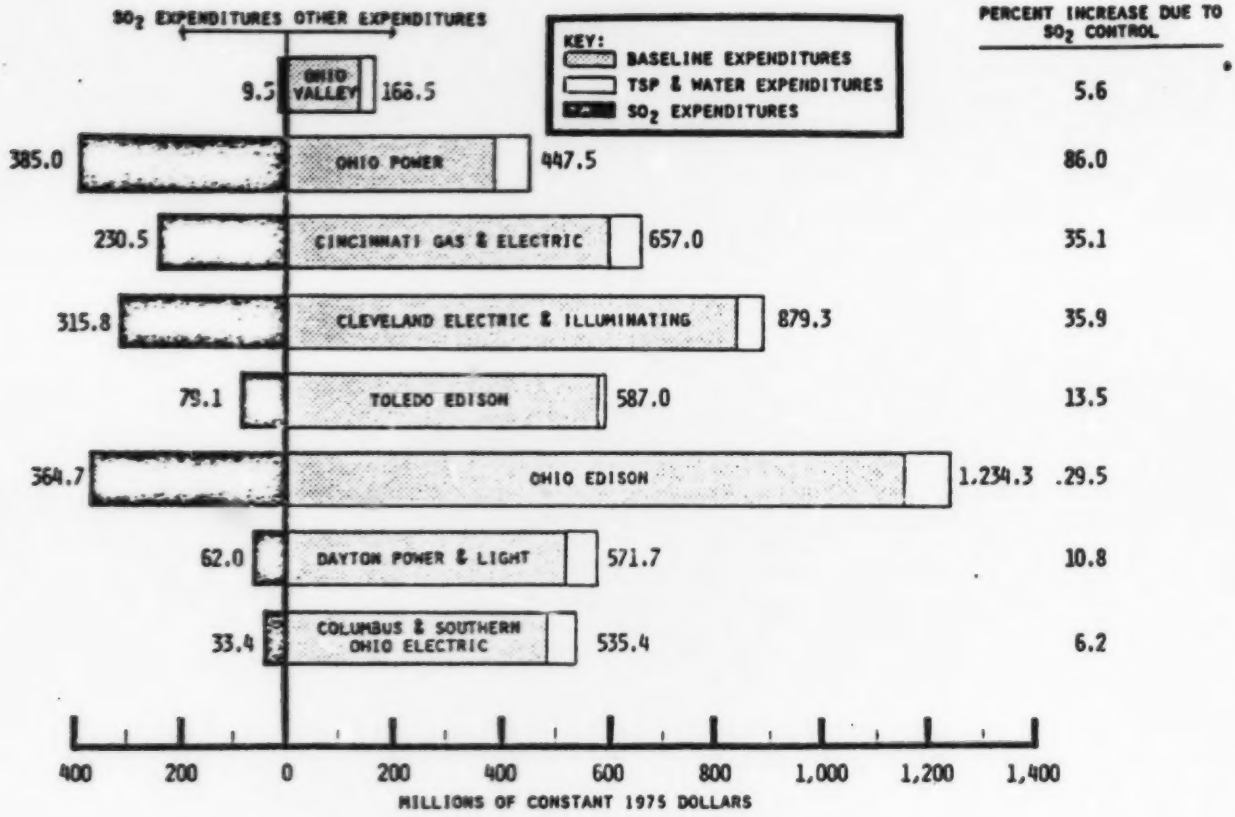
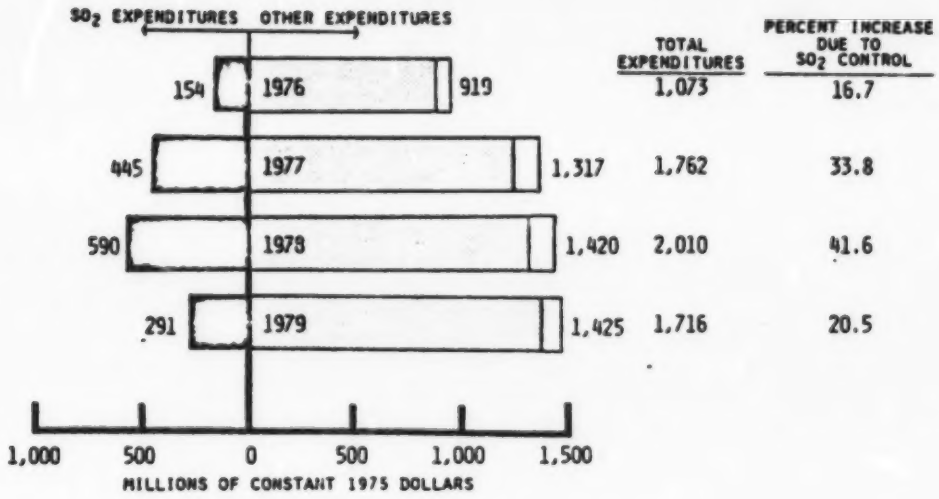


FIGURE 13

PROJECTED ANNUAL CAPITAL EXPENDITURES
OHIO INVESTOR-OWNED ELECTRIC UTILITIES
ORIGINAL PROPOSED SO_2 REGULATIONS



	TOTAL EXPENDITURES	PERCENT INCREASE DUE TO SO_2 CONTROL
1976	1,073	16.7
1977	1,762	33.8
1978	2,010	41.6
1979	1,716	20.5

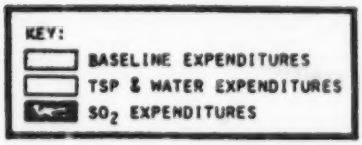


FIGURE 14

PROJECTED CUMULATIVE EXTERNAL FINANCING REQUIREMENTS
JANUARY 1, 1976-DECEMBER 31,1979
ORIGINAL PROPOSED SO_2 REGULATION

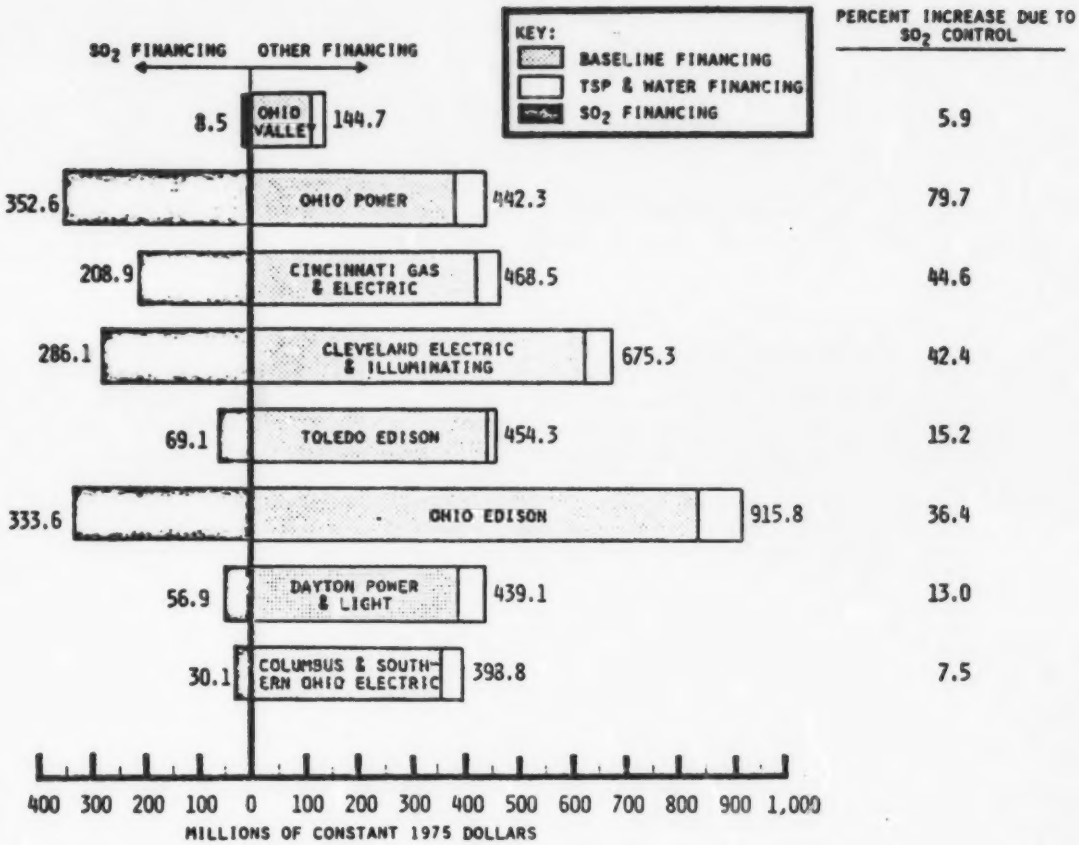
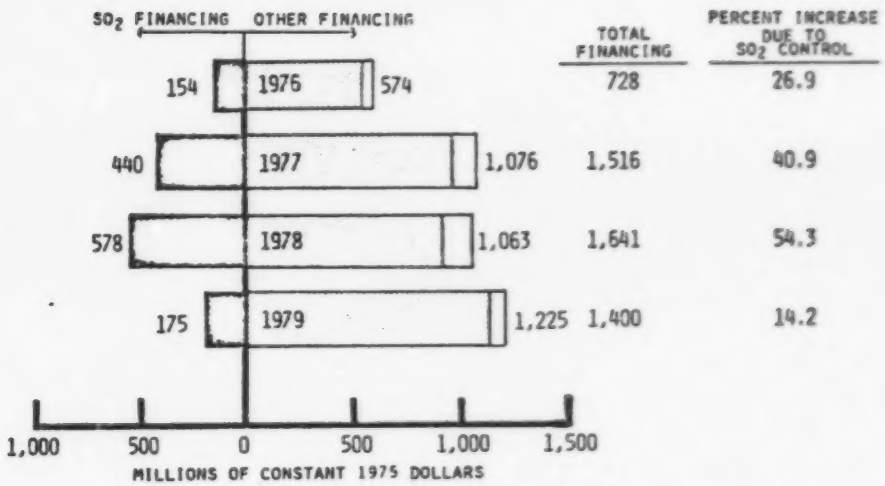
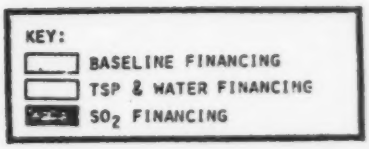


FIGURE 15

PROJECTED ANNUAL EXTERNAL FINANCING REQUIREMENTS
OHIO INVESTOR-OWNED ELECTRIC UTILITIES
ORIGINAL PROPOSED SO_2 REGULATIONS



	TOTAL FINANCING	PERCENT INCREASE DUE TO SO_2 CONTROL
1976	728	26.9
1977	1,516	40.9
1978	1,641	54.3
1979	1,400	14.2



The original SO_2 regulations would have caused an increase in external financing requirements for the years 1976, 1977, 1978, and 1979 of 26.9, 40.9, 54.3, and 14.2 percent, respectively. The total external financing requirements for the period 1976-1979 would have been $3,938 million for non-$SO_2$ items and $1,347 million for SO_2 control.

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APPENDIX A
SUMMARY OF FINANCIAL DATA

The following tables give all the financial data used in developing the conclusions of this report. Each of the investor-owned utilities in Ohio was modeled four times:

- Baseline--Excludes all expenditures for pollution control equipment (PCE) on existing power plants in Ohio. Includes all other planned expenditures on plant and equipment including PCE expenditures on existing plants outside Ohio and new plants.

- TSP & Water--Excludes all PCE expenditures for SO_2 removed on existing plants. Includes Baseline plus PCE expenditures for meeting particular (TSP) regulations and effluent guidelines on existing plants and all PCE expenditures on new plants. PCE costs for TSP and water were provided by the EPA.

- Revised SO_2 Regulation--Includes costs of complying with the revised SO_2 regulations in addition to the Baseline and expenditures to meet the TSP and water regulations.

- Original SO_2 Regulations--Includes costs of complying with the original proposed SO_2 regulations in addition to the Baseline and expenditures to meet the TSP and water regulations.

The column headings are defined as follows:

CAP EXP--Capital expenditures: Annual cash outlays made for plant and equipment (including construction work in progress) plus allowance for funds used during construction (millions of 1975 dollars).

EXT FIN--External Financing: Annual amount of funds which must be raised in financial markets through issuance of long-term debt, preferred stock, common stock, and short-term debt (millions of 1975 dollars).

OPER REV--Operating Revenues: Annual revenues required by operating and maintenance costs, fuel costs, interest charges, depreciation charges, and income and property taxes (millions of 1975 dollars).

O&M EXP--Operating and Maintenance Expenses: Annual operating and maintenance expenditures including fuel costs (millions of 1975 dollars).

CONS CHRG--Consumer Charges: Average cost (in 1975 mills) of electricity per kilowatt-hour sold. Determined by dividing annual operating revenues by the total kilowatt-hour sales for the year.

APPENDIX A
SUMMARY OF FINANCIAL DATA

CINCINNATI GAS & ELECTRIC COMPANY

Baseline

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	73.60	27.08	361.61	201.11	28.10
1977	152.33	107.44	385.09	215.66	27.80
1978	181.64	142.32	413.65	232.47	28.11
1979	191.90	139.03	442.20	238.42	28.36
1980	185.99	123.15	500.59	264.58	30.14
1981	195.19	126.49	544.45	286.11	30.92
1982	212.06	150.54	593.03	312.06	31.54
1983	217.25	151.69	642.50	339.31	31.99
1984	210.31	126.94	729.32	372.10	33.94
1985	255.98	173.41	780.42	401.90	34.04

TSP & Water

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	79.62	33.05	361.95	201.11	28.13
1977	169.68	124.57	386.31	215.66	27.89
1978	204.54	164.67	416.02	232.47	28.27
1979	203.16	146.17	450.37	241.36	28.88
1980	185.99	119.95	514.13	267.56	30.95
1981	195.19	123.46	557.50	289.11	31.66
1982	212.06	147.69	605.60	315.09	32.21
1983	217.25	149.00	654.59	342.37	32.59
1984	210.31	124.40	742.11	375.18	34.54
1985	255.98	171.00	792.74	405.11	34.57

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

CINCINNATI GAS & ELECTRIC COMPANY (CON'T)

Revised SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	87.20	40.58	362.38	201.11	28.16
1977	191.57	146.17	387.85	215.66	28.00
1978	233.42	192.85	419.00	232.47	28.47
1979	217.36	154.75	459.81	243.86	29.49
1980	185.99	115.52	530.21	270.10	31.92
1981	195.19	119.28	572.88	291.67	32.54
1982	212.06	143.74	620.27	317.66	32.99
1983	217.25	145.27	668.57	344.95	33.29
1984	210.31	120.89	756.91	377.77	35.22
1985	255.98	167.69	806.76	407.79	35.19

Original SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	103.72	56.98	363.31	201.11	28.23
1977	239.22	193.20	391.19	215.66	28.24
1978	296.29	254.21	425.49	232.47	28.91
1979	248.28.	173.00	486.84	255.16	31.22
1980	185.99	105.45	571.63	281.47	34.41
1981	195.19	109.78	612.68	303.09	34.80
1982	212.06	134.77	658.47	329.13	35.02
1983	217.25	136.81	705.20	356.48	35.11
1984	210.31	112.90	795.25	389.34	37.01
1985	255.98	160.16	843.37	419.55	36.78

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

CLEVELAND ELECTRIC ILLUMINATING COMPANY

Baseline

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	130.21	69.72	479.45	295.44	28.10
1977	248.10	264.98	553.28	328.88	30.09
1978	221.38	146.41	617.10	337.94	31.57
1979	237.75	156.49	654.65	360.07	31.66
1980	264.92	201.39	713.73	389.72	32.65
1981	275.84	178.07	764.71	403.85	33.30
1982	290.68	196.23	813.93	416.71	33.70
1983	357.05	272.59	857.77	426.34	33.82
1984	432.18	303.11	946.32	437.28	35.58
1985	455.44	330.03	996.68	447.07	35.51

TSP & Water

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	134.57	74.05	479.67	295.44	28.12
1977	260.70	277.40	554.06	328.88	30.13
1978	238.05	162.66	618.56	337.94	31.64
1979	245.96	161.18	660.25	361.32	31.93
1980	264.92	198.55	723.23	391.00	33.09
1981	275.84	175.40	773.71	405.15	33.69
1982	290.68	193.71	822.45	418.01	34.05
1983	357.05	270.21	865.82	427.65	34.14
1984	432.18	300.87	954.76	438.60	35.89
1985	455.44	327.92	1004.58	448.40	35.79

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

CLEVELAND ELECTRIC ILLUMINATING COMPANY (CON'T)

Revised SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	155.68	95.00	480.75	295.44	28.18
1977	321.67	337.58	557.83	328.88	30.34
1978	318.76	241.36	625.63	337.94	32.60
1979	285.73	186.29	688.49	370.57	33.38
1980	264.92	187.08	771.13	400.66	35.20
1981	275.84	164.57	819.82	414.99	35.70
1982	290.68	183.49	866.73	427.99	35.80
1983	357.05	260.57	908.28	437.73	35.81
1984	432.18	291.78	999.62	448.77	37.08
1985	455.44	319.35	1047.22	458.67	37.31

Original SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	167.48	106.70	481.35	295.44	28.21
1977	355.78	371.22	559.94	328.88	30.45
1978	363.87	285.35	629.58	337.94	32.21
1979	307.96	198.10	711.79	381.02	34.42
1980	264.92	178.58	805.14	411.54	36.83
1981	275.84	156.56	852.47	426.07	37.12
1982	290.68	175.94	898.02	439.20	37.18
1983	357.05	253.46	938.22	449.05	36.99
1984	432.18	285.08	1030.59	460.20	38.74
1985	455.44	313.03	1076.67	470.19	38.36

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

COLUMBUS AND SOUTHERN OHIO ELECTRIC COMPANY

Baseline

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	79.29	55.26	255.38	153.68	31.53
1977	126.43	87.93	300.08	163.74	34.81
1978	139.68	101.97	331.35	182.68	36.09
1979	142.76	110.55	361.93	190.58	37.00
1980	139.64	132.08	391.35	199.68	37.66
1981	154.95	102.60	422.90	220.18	38.33
1982	185.33	161.96	460.33	233.09	39.31
1983	190.25	150.38	494.91	256.93	39.84
1984	191.06	168.73	560.35	273.42	42.53
1985	232.81	157.05	600.16	302.01	42.96

TSP & Water

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	84.19	60.12	255.61	153.68	31.56
1977	140.63	101.94	300.87	163.74	34.90
1978	158.51	120.33	332.84	182.68	36.25
1979	152.06	116.40	368.23	192.78	37.65
1980	139.64	129.38	402.37	201.98	38.72
1981	154.95	100.05	433.43	222.44	39.28
1982	185.33	159.55	470.51	235.43	40.18
1983	190.25	148.11	504.63	259.25	40.62
1984	191.06	166.59	570.71	275.83	43.32
1985	232.81	155.03	609.94	304.37	43.66

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

COLUMBUS AND SOUTHERN OHIO ELECTRIC COMPANY (CON'T)

Revised SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	88.19	64.09	255.79	153.68	31.58
1977	152.19	113.35	301.52	163.74	34.98
1978	173.86	135.29	334.06	182.68	36.38
1979	159.64	121.14	374.82	195.95	38.32
1980	139.64	127.15	412.74	205.18	39.72
1981	154.95	97.95	443.43	225.63	40.19
1982	185.33	157.57	480.18	238.66	41.01
1983	190.25	146.24	513.94	262.48	41.37
1984	191.06	164.83	580.50	279.09	44.06
1985	232.81	153.37	619.28	307.63	44.33

Original SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	87.66	63.57	255.77	153.68	31.58
1977	150.67	111.84	301.44	163.74	34.97
1978	171.84	133.31	333.90	182.68	36.37
1979	158.64	120.22	378.32	199.48	38.68
1980	139.64	127.17	415.68	208.71	40.00
1981	154.95	97.96	446.38	229.17	40.46
1982	185.33	157.58	483.12	242.20	41.26
1983	190.25	146.26	516.89	266.03	41.61
1984	191.06	164.84	583.34	282.65	44.28
1985	232.81	153.38	622.15	311.20	44.53

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

DAYTON POWER & LIGHT COMPANY

Baseline

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	56.12	22.60	286.20	169.41	31.34
1977	130.90	98.18	304.46	180.67	31.51
1978	161.31	141.83	328.52	196.37	32.05
1979	171.58	129.10	358.99	209.65	33.04
1980	168.49	117.73	397.74	221.96	34.52
1981	177.84	152.12	433.80	237.91	35.51
1982	189.24	139.62	473.55	259.17	36.58
1983	183.99	121.88	516.06	282.66	37.59
1984	168.86	108.07	588.84	309.89	40.45
1985	203.99	136.19	629.24	332.64	40.77

TSP & Water

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	61.50	27.95	286.49	169.41	31.38
1977	146.47	113.55	305.48	180.67	31.61
1978	181.97	162.02	330.39	196.37	32.24
1979	181.77	135.54	366.29	212.32	33.71
1980	168.49	114.79	409.87	224.59	35.58
1981	177.84	149.35	445.29	240.51	36.45
1982	189.24	137.01	484.43	261.77	37.42
1983	183.99	119.41	526.37	285.27	38.34
1984	168.86	105.74	599.63	312.47	41.19
1985	203.99	133.99	639.54	335.37	41.44

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

DAYTON POWER & LIGHT COMPANY (CON'T)

Revised SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	63.70	30.12	286.61	169.41	31.39
1977	152.81	119.82	305.89	180.67	31.66
1978	190.39	170.24	331.16	196.37	32.31
1979	185.93	138.25	369.33	213.53	33.99
1980	168.49	113.67	414.90	225.79	36.01
1981	177.84	148.29	450.08	241.72	36.85
1982	189.24	136.00	489.00	262.98	37.77
1983	183.99	118.46	530.71	286.48	38.66
1984	168.86	104.84	604.20	313.68	41.51
1985	203.99	133.14	643.87	336.60	41.72

Original SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	67.94	34.34	286.84	169.41	31.41
1977	165.10	131.96	306.70	180.67	31.74
1978	206.69	186.17	332.64	196.37	32.46
1979	193.98	143.48	376.86	217.47	34.68
1980	168.49	111.50	426.30	229.73	37.00
1981	177.84	146.24	461.02	245.66	37.74
1982	189.24	134.06	499.50	266.93	38.58
1983	183.99	116.63	540.80	290.44	39.39
1984	168.86	103.11	614.72	317.65	42.23
1985	203.99	131.51	653.94	340.61	42.37

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

OHIO EDISON COMPANY

Baseline

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	270.42	176.25	544.52	339.46	29.51
1977	264.52	205.04	647.17	362.24	33.20
1978	287.25	216.83	691.15	382.68	33.66
1979	329.73	241.85	746.05	420.59	34.51
1980	349.36	297.02	814.59	450.64	35.79
1981	351.55	348.42	876.69	461.75	36.60
1982	370.90	248.20	932.04	471.29	37.00
1983	433.77	299.19	985.66	478.33	37.24
1984	481.28	352.50	1099.08	490.38	39.54
1985	509.58	360.43	1162.44	501.44	39.81

TSP & Water

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	278.94	184.73	544.93	339.46	29.53
1977	289.22	229.49	648.53	362.24	33.27
1978	320.12	249.07	693.46	382.68	33.78
1979	345.99	252.48	757.27	424.91	35.03
1980	349.36	292.68	834.17	455.12	36.65
1981	351.55	344.31	895.56	466.27	37.39
1982	370.90	244.31	950.17	475.82	37.72
1983	433.77	295.51	1003.05	482.86	37.89
1984	481.28	349.02	1117.48	494.94	40.20
1985	509.58	357.14	1179.97	506.03	40.41

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

OHIO EDISON COMPANY (CON'T)

Revised SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	286.31	192.05	545.30	339.46	29.55
1977	310.58	250.63	649.70	362.24	33.33
1978	346.54	276.95	695.46	382.68	35.37
1979	360.04	261.63	768.37	429.96	35.55
1980	349.36	288.90	852.40	460.23	37.45
1981	351.55	340.73	913.16	471.40	38.13
1982	370.90	240.92	967.14	480.96	38.39
1983	433.77	292.30	1019.39	488.01	38.51
1984	481.28	345.98	1134.68	500.11	40.32
1985	509.58	354.26	1196.40	511.22	40.58

Original SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	316.70	222.26	546.79	339.46	29.63
1977	398.62	337.77	654.56	362.24	33.58
1978	465.69	391.88	703.70	382.68	34.28
1979	417.99	297.48	808.88	444.09	37.42
1980	349.36	271.52	921.95	474.63	40.50
1981	351.55	324.28	979.71	485.88	40.90
1982	370.90	225.35	1030.68	495.48	40.91
1983	433.77	277.57	1079.99	502.56	40.80
1984	481.28	332.05	1198.53	514.72	43.11
1985	509.58	341.08	1256.79	525.89	43.04

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

OHIO POWER COMPANY

Baseline

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	90.65	31.84	841.56	519.56	19.74
1977	65.36	9.43	879.13	559.78	19.43
1978	107.38	46.11	928.42	602.17	19.55
1979	120.67	295.31	967.72	636.28	19.98
1980	118.47	25.31	1040.18	700.97	20.12
1981	122.20	60.39	1109.36	764.51	20.01
1982	126.06	101.39	1188.72	836.89	19.94
1983	149.04	132.43	1270.79	911.36	19.97
1984	226.37	143.03	1317.66	941.85	20.62
1985	320.22	231.95	1348.53	958.45	21.40

TSP & Water

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	97.24	38.43	841.95	519.56	19.75
1977	84.44	28.48	880.36	559.78	19.45
1978	132.70	71.34	930.38	602.17	19.59
1979	133.17	304.03	975.54	639.65	20.14
1980	118.47	22.55	1053.35	704.55	20.37
1981	122.20	57.74	1122.29	768.30	20.25
1982	126.06	98.86	1201.46	840.93	20.15
1983	149.04	129.98	1283.24	915.65	20.16
1984	226.37	140.49	1329.87	946.24	20.81
1985	320.22	229.38	1361.20	962.90	21.60

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

TBS

OHIO POWER COMPANY (CON'T)

Revised SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	104.31	45.49	842.37	519.56	19.76
1977	104.88	48.90	881.67	559.78	19.48
1978	159.83	98.38	932.96	602.17	19.64
1979	146.56	309.40	986.92	642.06	20.38
1980	118.47	15.78	1069.02	707.03	20.68
1981	122.20	51.28	1137.00	770.85	20.51
1982	126.06	92.54	1214.73	843.56	20.37
1983	149.04	123.81	1296.33	918.36	20.37
1984	226.37	134.63	1342.41	948.99	21.01
1985	320.22	223.85	1372.69	965.67	21.79

Original SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	137.23	78.39	844.29	519.56	19.80
1977	200.14	143.81	887.56	559.78	19.61
1978	286.23	222.76	943.23	602.17	19.86
1979	208.96	349.89	1023.05	649.88	21.12
1980	118.47	-1.21	1128.47	715.17	21.83
1981	122.20	34.95	1194.62	779.32	21.55
1982	126.06	76.99	1270.60	852.39	21.31
1983	149.04	109.03	1349.56	927.57	21.20
1984	226.37	120.71	1395.92	958.35	21.84
1985	320.22	210.83	1422.84	975.13	22.58

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

OHIO VALLEY ELECTRIC CORPORATION

Baseline

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	26.75	24.74	181.21	156.44	9.93
1977	62.70	57.76	184.98	161.00	10.14
1978	40.93	32.83	188.47	166.68	10.33
1979	8.58	3.58	194.36	173.61	10.66
1980	.70	.00	205.56	181.37	11.27
1981	.69	.00	209.41	186.56	11.48
1982	.68	.00	213.26	191.92	11.69
1983	.66	-5.88	212.76	197.45	11.66
1984	.65	-5.62	217.33	203.14	11.91
1985	.64	-5.38	222.15	209.02	12.18

TSP & Water

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	29.53	27.40	181.34	156.44	9.94
1977	70.90	65.36	185.35	161.00	10.16
1978	52.04	42.59	188.96	166.68	10.36
1979	15.20	9.35	196.31	174.71	10.76
1980	.70	.00	209.03	182.47	11.46
1981	.69	.00	212.79	187.67	11.67
1982	.68	.00	216.53	193.03	11.87
1983	.66	-7.42	217.35	198.56	11.92
1984	.65	-7.10	221.62	204.26	12.15
1985	.64	-6.79	226.17	210.14	12.40

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

TBS

OHIO VALLEY ELECTRIC CORPORATION (CON'T)

Revised SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O•M EXP	CONS CHRG
1976	29.53	27.40	181.34	156.44	9.94
1977	70.90	65.36	185.35	161.00	10.16
1978	52.04	42.59	188.96	166.68	10.36
1979	15.20	9.35	196.31	174.71	10.76
1980	.70	.00	209.03	182.47	11.46
1981	.69	.00	212.79	187.67	11.67
1982	.68	.00	216.53	193.03	11.87
1983	.66	-7.42	217.35	198.56	11.92
1984	.65	-7.10	221.62	204.26	12.15
1985	.64	-6.79	226.17	210.14	12.40

Original SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O•M EXP	CONS CHRG
1976	30.45	28.28	181.38	156.44	9.94
1977	73.61	67.88	185.47	161.00	10.17
1978	55.72	45.83	189.12	166.68	10.37
1979	17.39	11.26	197.71	175.82	10.84
1980	.70	.00	210.94	183.59	11.56
1981	.69	.00	214.66	188.79	11.77
1982	.68	.00	218.37	194.15	11.97
1983	.66	-7.93	219.62	199.68	12.04
1984	.65	-7.59	223.80	205.39	12.27
1985	.64	-7.26	228.26	211.27	12.51

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

TBS

TOLEDO EDISON COMPANY

Baseline

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	152.77	127.94	223.52	133.68	30.97
1977	152.18	133.43	243.94	137.52	31.94
1978	129.32	88.05	272.57	125.58	33.97
1979	146.35	99.54	283.90	133.05	34.31
1980	171.89	125.03	312.79	146.02	35.15
1981	170.94	111.07	345.55	154.93	35.65
1982	150.42	110.51	374.24	161.89	35.46
1983	160.07	87.12	395.32	164.69	35.52
1984	190.06	118.77	442.29	169.46	37.89
1985	201.23	144.74	469.83	174.03	38.14

TSP & Water

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	153.43	128.59	223.56	133.68	30.97
1977	154.09	135.31	244.07	137.52	31.96
1978	131.84	90.50	272.81	125.58	34.00
1979	147.59	99.90	284.98	133.19	34.44
1980	171.89	124.27	314.37	146.16	35.32
1981	170.94	110.36	346.98	155.08	35.80
1982	150.42	109.84	375.53	162.04	35.58
1983	160.07	86.49	396.48	164.84	35.62
1984	190.06	118.18	443.45	169.61	37.99
1985	201.23	144.20	470.86	174.18	38.22

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

TBS

TOLEDO EDISON COMPANY (CON'T)

Revised SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	160.56	135.65	223.95	133.68	31.03
1977	174.67	155.58	245.45	137.52	32.14
1978	159.08	116.97	275.39	125.58	34.32
1979	161.02	107.08	296.61	137.65	35.84
1980	171.49	119.19	332.22	150.74	37.33
1981	170.94	105.57	363.96	159.73	37.55
1982	150.42	105.33	391.63	166.71	37.10
1983	160.07	82.25	411.68	169.49	36.99
1984	190.06	114.19	459.21	174.26	39.34
1985	201.23	140.44	485.66	178.84	39.42

Original SO_2 Regulation

	CAP EXP	EXT FIN	OPER REV	O+M EXP	CONS CHRG
1976	161.68	136.77	224.02	133.68	31.04
1977	177.92	158.77	245.67	137.52	32.16
1978	163.38	121.14	275.79	125.58	34.37
1979	163.13	106.70	298.86	137.42	36.11
1980	171.89	116.97	335.25	150.66	37.67
1981	170.94	103.49	366.62	159.73	37.82
1982	150.42	103.37	393.87	166.72	37.32
1983	160.07	80.41	413.49	169.47	37.15
1984	190.06	112.47	460.84	174.20	39.48
1985	201.23	138.83	486.91	178.77	39.52

Note: All figures in millions of 1975 constant dollars except Consumer Charges (CONS CHRG), which are in mills per kilowatt-hour.

APPENDIX B
COSTS OF POLLUTION CONTROL STRATEGIES

The following chart shows the type of pollution control strategies and their associated costs provided to TBS for use in this analysis.

The capital costs and O/M (operating and maintenance, including fuel) costs shown are in 1975 dollars and do not include the cost of replacing, operating, or installing pollution control equipment on the derated capacity. The cost of replacing and operating the derated capacity was included when performing the analysis.

These costs came from a variety of sources. The costs of meeting particulate regulations and effluent guidelines were provided by EPA and PEDCO. The costs involved with complying with the proposed and revised SO_2 regulations were provided by Energy and Environmental Analysis (EEA) and PEDCO. The derate figures were provided by EEA and modified by TBS to reflect installation of pollution control equipment on the replacement capacity.

Appendix B

CAPITAL AND OPERATING COSTS OF POLLUTION CONTROL STRATEGIES

(costs in millions of 1975 dollars)

Company	Particulate (TSP)			Effluent Guidelines			Proposed SO_2 Regulations			Revised SO_2 Regulations		
	Capital[1] Cost	O/M[2] Cost	Derate[3] (mw)	Capital[1] Cost	O/M[2] Cost	Derate[3] (mw)	Capital[1] Cost	O/M[2] Cost	Derate[3] (mw)	Capital[1] Cost	O/M[2] Cost	Derate[3] (mw)
Dayton Power and Light Company	$17.51	$1.02	5.04	$15.97	$0	7.02	$ 46.25	$ 4.57	7.74	$ 15.79	$1.06	2.81
Columbus & Southern Ohio Electric Company	21.91	1.28	6.31	9.91	0	11.46	25.24	6.50	3.71	28.63	2.88	5.21
Cincinnati Gas and Electric Company	33.73	1.95	9.69	7.08	0	7.50	173.53	11.98	29.96	54.96	1.95	9.67
Ohio Valley Electric Company	10.62	1.08	5.35	-	-	-	6.71	1.11	0	-	-	-
Toledo Edison Company	1.73	0.10	0.49	3.19	0	0	50.58	1.33	35.26	49.43	3.15	15.22
Cleveland Electric Illuminating	15.55	0.90	4.47	16.61	0	0	208.38	9.35	127.21	152.43	4.71	62.65
Ohio Edison Company	40.12	2.33	11.54	15.18	0	18.9	266.73	16.23	57.91	52.78	4.37	9.96
Ohio Power Company	24.21	1.41	6.96	17.10	0	21.3	235.99	17.74	50.56	50.72	1.77	8.89
Municipals & Cooperatives	-	-	-	-	-	-	-	-	-	15.96	3.20	6.40

[1] *Capital costs do not include cost of replacing the capacity lost through derate or the cost of pollution control equipment for the replacement capacity. In this analysis, this lost capacity was replaced at a cost of $413 per kilowatt, in 1979 dollars, plus the cost of pollution control equipment.*

[2] *Operating and maintenance costs do not include the cost of operating the new capacity which replaces the derate and the pollution control equipment installed on the new capacity. These costs were determined and included in the course of this analysis.*

[3] *The amount of derate capacity was increased by TBS to reflect the installation of pollution control equipment on the derate replacement capacity.*

Source: EPA, EEA, PEDO